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GALLATIN, PARK & SWEET GRASS COUNTIES



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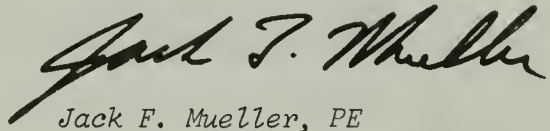
Gentlemen:

In accordance with our agreement for water and sewer planning for forty nine of the fifty six counties in Montana, we hereby submit this Comprehensive Area-Wide Water and Sewer Plan.

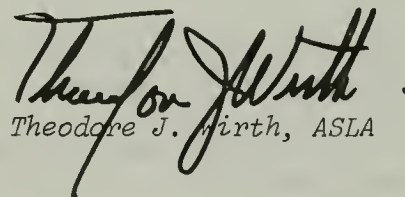
This report is based on engineering and planning studies made throughout the county areas. The population characteristics and trends, the economics, and the natural resources of the counties were carefully analyzed. Based on information gathered from the study and on examination of existing water and sewer facilities, recommendations for new or improved water and sewer facilities were made where applicable.

We wish to express our appreciation for the cooperation we received from the federal and state agencies we have worked with and from the administrative agencies, from the community and civic leaders, and from the residents of the counties involved.

Respectfully submitted,



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INTRODUCTION

The State of Montana is basically rural in nature with the vast majority of its people still living in small rural communities and there is every indication this situation will prevail for many years. It is important, therefore, to provide adequate and suitable water and sewer facilities for this rural population. It is just as important as for the larger urban areas, but this need of rural communities is often overlooked in our rapidly urbanizing society.

This Comprehensive Water and Sewer Study analyzes the present state of water supply and sewage disposal and is based on projected changes in population, economy, and land use. It projects improvements and additions required to meet needs during the next twenty years. Although the report is technical in nature, every effort has been taken to make it understandable to any interested person while retaining those details required for persons responsible for engineering these facilities. Adequate water and sewer facilities can be provided only with the active support of an informed and concerned citizenry.

While the general purpose of this study is to provide information necessary for coordinated planning of water and sewer facilities on a county wide basis, the specific aims of the study are to:

1. Develop an awareness on the part of the people of rural areas as to their water and sewer problems and needs.
2. Provide the information necessary for a concerned citizenry to be properly informed on water and sewer problems and needs.
3. Develop on the part of the people affected a desire to solve present or projected problems connected with water and waste disposal.
4. Suggest best and alternative sources of water and methods of waste disposal.
5. Prevent unnecessary duplication and underdesign or overdesign of water and sewer facilities.
6. Coordinate use of common facilities such as water supplies and waste treatment plants.

This plan encompasses all rural communities within the county containing five or more dwelling units but having a population of less than 5,500. The requirements of the Farmers Home Administration, which funded the project, and the Montana Department of Planning and Economic Development concerning water and sewer plans are satisfied by this study.

VOLUME 14

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GALLATIN COUNTY

MONTANA

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CONCLUSIONS, RECOMMENDATIONS, AND PRIORITIES

Conclusions

The total population of Gallatin County is expected to increase substantially during the planning period. This increase will take place throughout the county in general; however, Bozeman will experience the largest growth. This community is the largest town in the county and was not included in this study because its population is presently greater than 5,500. Practically all other communities in the county will experience population growth.

The systems which are presently in operation throughout the county are in generally good condition; although, improvements are needed for many of them. Many of the smaller communities could feasibly construct sanitary facilities, and in some cases the improvements are very much needed.

Proposals for improvements to existing systems have been mentioned where necessary, and the development of new sewer and water systems has been proposed where feasible. Local demand for improved sanitary facilities has not developed in many of the smaller communities. It is feasible to construct sanitary facilities in all but the very small communities of the county. It is anticipated that the local demand for central sewer and water systems will develop in the near future.

Recommendations

This plan shows the various types of improvements which the communities should be considering during the planning period. Elaborate systems are not proposed but rather those facilities necessary to provide safe and adequate community systems. It is recommended that this general plan be adopted by the governing agencies of each community. A detailed approach, which must be undertaken to insure completion of the improvements in each community, cannot be covered in a report of this type. Community leaders, however, do have several courses of action which may be taken.

Most small communities do not have the means to plan and finance complete water and sewer systems. Therefore, to enable communities to acquire such facilities, five departments of the Federal Government have legislation authorizing loans or grants for construction of public works. These agencies are:

Farmers Home Administration
United States Department of Agriculture
P.O. Box 850
Bozeman, Montana 59715

Federal Water Quality Administration
United States Department of the Interior
% Montana State Department of Health
Helena, Montana 59601

Public Health Service
United States Department of Health, Education, and Welfare
Division of Indian Health
Billings, Montana 59101

Administration for Metropolitan Development
United States Department of Housing and Urban Development
Assistant Regional Administrator
Denver Regional Office
1050 South Broadway
Denver, Colorado 80209

Economic Development Administration
United States Department of Commerce
Montana Field Coordinator
207 Medical Arts Building
Butte, Montana 59701

The legislation is constantly changing; therefore, community leaders should investigate the various alternatives and determine which program and course of action would be most beneficial to them.

Priorities

That a particular system requires immediate improvements and another system will be satisfactory for a definite period are difficult to establish. Several indicators for establishing priorities are available, however. The general health of the people is the prime consideration, and this can only be insured when safe water supplies are provided. Water supply in adequate quantities is another important factor. Waste water must be treated and disposed of by safe methods to minimize the problems of pollution and to protect public health. The total number of persons benefited by any improvement must also be considered. These basic criteria were used in establishing the following priority listing:

1. Belgrade Sewer System. The present lack of adequate sewer

system facilities for part of the town makes this project necessary. Sufficient population resides there to make the project feasible.

2. West Yellowstone Water System. The high water usage experienced during the summer months makes this project necessary. There is sufficient permanent population as well as additional summer population to make the project feasible.

3. Amsterdam-Churchill Sewer System. The need for improved sanitary facilities and the elimination of an existing pollution problem make this project necessary. Sufficient population presently resides there to make the project feasible.

4. Bozeman Hot Springs Sewer System. Sufficient population presently resides there to make the project feasible. The elimination of possible well contamination makes the project necessary.

5. Gallatin Gateway Sewer System. The elimination of the present operational problems experienced with the private systems makes the project necessary, and there is sufficient population to make the project feasible.

6. Willow Creek Sewer System. Sufficient population presently resides there to make the project feasible. The elimination of operational problems presently experienced with private sewers and the elimination of a pollution problem make the project necessary.

7. Three Forks Sewer System. The elimination of a potential pollution problem makes this project necessary. It is feasible to replace the existing collection system.

8. Three Forks Water System. The replacement of the water supply line is a necessary improvement for this community.

9. Belgrade Water System. Additional water service will be necessary for this community. The population is increasing and additional facilities are necessary.

10. Manhattan Water System. The existing supply line has deteriorated, and it will be necessary to replace this facility during the planning period.

11. Manhattan Sewer System. It is feasible to extend the existing collection system to the existing residences in the community.

12. Bozeman Hot Springs Water System. The population is increasing in this community, and the need for central water system facilities will become apparent during the planning period.

13. Gallatin Gateway Water System. Improved water supply is needed for this community. Sufficient population resides there to make the project feasible.

14. Amsterdam-Churchill Water System. Sufficient population resides there to make the project feasible. The need for improved water supply makes the project necessary.

15. Willow Creek Water System. Sufficient population presently resides there to make the project feasible. The need for improved water supply makes the project feasible.

16. Logan Sewer System. This improvement is not immediately needed; however, sufficient population presently resides there to make the project feasible.

17. Logan Water System. Sufficient population presently resides there to make the project feasible; however, the local demand for such an improvement has not developed.

This list of priorities is not intended to govern the order in which action should be taken. The order merely ranks the severity of the problems and the need for improvements.

THE LAND

General Characteristics

Gallatin County, located in south central Montana, is surrounded by five counties and two states. The narrow, elongated county is bordered to the west by Madison and Jefferson Counties, to the north by Broadwater and Meagher Counties, to the east by Park County, and to the south by the States of Idaho and Wyoming. The total area is 2,540 square miles of which twenty three square miles represent water surface area. The Madison, Missouri, and Gallatin Rivers and Hebgen Lake account for most of the water surface area.

As seen by the topography on Map 1, Gallatin County is characterized by land that is mountainous with broad river valleys used for crop raising or range lands for livestock. Elevations vary from Hyalite Peak at 10,299 feet to 4,196 feet at the town of Trident. The population concentration is mainly in and around the city of Bozeman, the largest town and county seat, which has developed into a major shopping, educational, and industrial center in the state.

The transportation network of the county is made up of numerous

federal, state, and county roads. Interstate 90 is the main east to west route and, serving Bozeman, extends to Livingston in the east and to Butte in the west. U. S. Highway 191 travels from West Yellowstone northward to Bozeman Hot Springs where it forks eastward to Bozeman or continues northward as State Secondary 291 to Belgrade. U. S. Highway 10, paralleling Interstate 90, travels from Bozeman to Belgrade and Logan and then connects with Interstate 90 at Manhattan. Numerous secondary and county roads serve the more outlying areas.

Three railroads provide service to the county area. The main line of the Burlington-Northern Railroad crosses the county from east to west paralleling Interstate 90. Two passenger trains, the North Coast Limited and the Mainstreeter, serve the area four times daily, and the number of freight trains varies daily with local demand. In the western part of the Burlington-Northern route through the county, spur lines branch north and south leading to Helena and Anceney respectively. The Chicago, Milwaukee, St. Paul, and Pacific Railroad, an electrically driven train, has its hub station at Bozeman with lines running northward to Menard, southward to Gallatin Gateway, and westward to Three Forks and Butte and other western cities. The Union Pacific, offering passenger and freight services, travels northward from southern Idaho and terminates near the southern tip of the county at West Yellowstone.

The rough topography of the land limits the areas suitable for aircraft landing fields; although, with two airports, located at Bozeman and West Yellowstone, the county does have more commercial airports than almost any other county in this state. Air service facilities and daily connections to nation wide airlines are available at both towns.

Most of the power in the county is supplied by the Montana Power Company which has major switching and substations located at Trident and Bozeman. Distribution points are located at Trident, Manhattan, Belgrade, Mt. Ellis, Willow Creek, and Gallatin Gateway. The Chicago, Milwaukee, St. Paul, and Pacific Railroad which does not provide power for commercial use but solely for the railroad has a major switching station located at Trident.

Since major power producing centers and relay stations are usually located at widely separated points and provide power service to large areas, Map 2 shows the major power grid system for the entire State of Montana. Major gas transmission lines are also shown.

Mountain States Telephone supplies the entire area of the county with telephone service.

Land Ownership and Use

As seen on Chart 1, there are three main ownership categories in Gallatin County. The largest segment of land, fifty four percent or 1,376 square miles, consists of private ownership. Forty three percent, 1,077 square miles, is federal ownership while the remaining three percent of the land is owned by the State of Montana.

Land use in the county is generally reflected by the physical characteristics of the area. Diversified agricultural operations use sixty two percent, or 1,582 square miles of land. The Gallatin National Forest and a small part of the Beaverhead National Forest cover 902 square miles for a total of thirty six percent of the land use. Water surface area accounts for one percent of the land use, approximately twenty three square miles, and the remaining one percent is used for such miscellaneous purposes as town sites and transportation routes.

National Resources

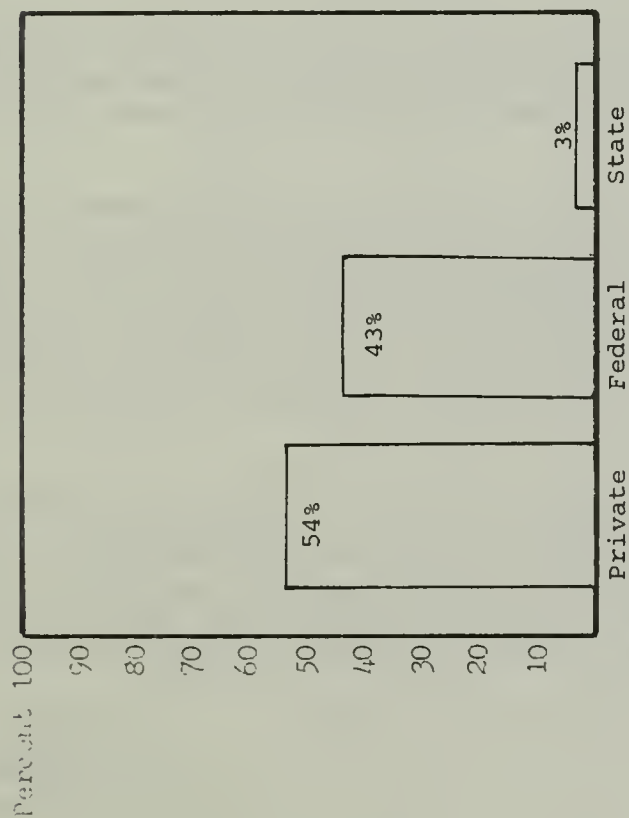
Even though agriculture was the primary reason for settling Gallatin County, mining also played a significant role. The Ideal Cement Company at Trident is the most important operation in the county, and limestone, sandstone, quartz, and quartzite, used in making cement, are quarried near the plant. The cement industry is increasing its activity as the demand rises in Montana and nearby states.

Forest lands are plentiful in the county. The Gallatin National Forest, for example, covers 577,468 acres. Four species of trees, Douglas fir, western larch, Engelmann Spruce, and Ponderosa pine predominate in these forests. Although most of the forested areas are on federal land, the county still receives twenty five percent of the moneys derived from the sale of timber and other forest uses within its boundaries. In the fiscal year 1969 this amount came to \$6,512.56.

The county, situated as it is in forested, mountainous area, provides excellent opportunities for outdoor recreation. The national forest areas supply ample camping and hiking facilities and provide ideal habitat for game animals such as moose, bear, and deer. Excellent fishing is found in the rivers and mountain streams. Game birds such as grouse, pheasant, and Hungarian partridge challenge the bird hunter. Yellowstone National Park, located at the southern border, provides a full range of recreation and vacation facilities. A point of interest to tourists is the Madison River Canyon, the area where an earthquake and disastrous landslide occurred in 1959. As the area's potential for recreation is increasingly recognized, this industry will play a principal role of increasing importance in the growth of the county's population and in its economy.

CHART 1

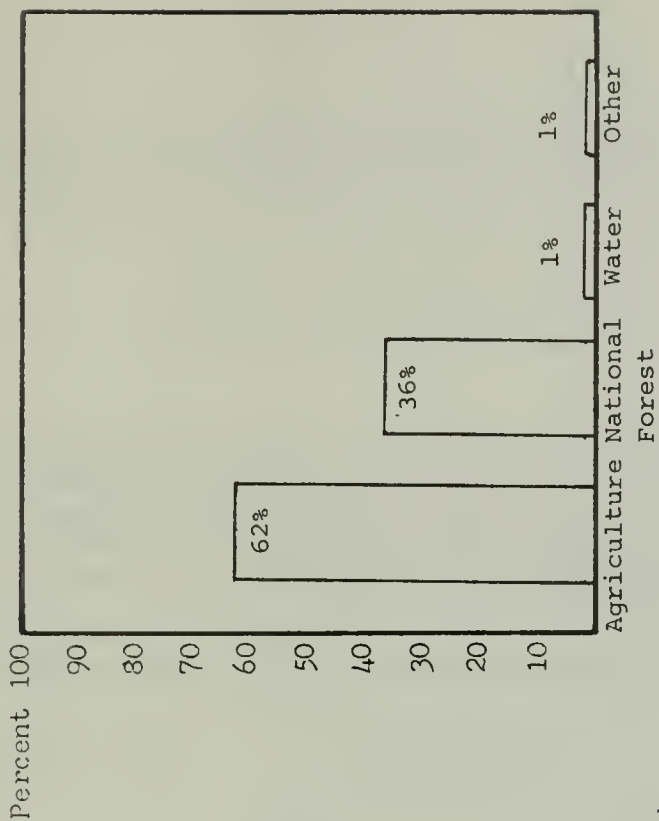
Land Ownership
Gallatin County



Square miles 1,376 1,077 87

CHART 2

Land Use
Gallatin County



Square miles 1,582 902 23 33

- Sources: 1. The Montana Almanac, 1950-60
 2. Forest Service, U. S. Department of Agriculture
 3. U. S. Census of Agriculture, 1964

Soils

The majority of the county, as indicated by the land use, is covered by rich, agriculture supporting soils of high crop producing quality. Most of the soils in the southern part support extensive forests with some high range lands.

Soils are covered in more detail later in this report.

Water

The major drainage system in the county is composed of the Missouri River and its tributaries, the Gallatin, Madison, and Jefferson Rivers and Sixteen Mile Creek. The Gallatin River drains the central southern regions of the county; the Madison River drains the northwestern section and an extreme southern portion, and the Missouri River and Sixteen Mile Creek drain the northern areas.

Water resources are covered in more detail later in this report.

THE PEOPLE

Population

For analytical and projective purposes, it is necessary to study the population history of Gallatin County to find out what has happened and what is going to happen. Chart 3 graphically shows the growth of the county as compared with that for Montana and indicates the future growth for both.

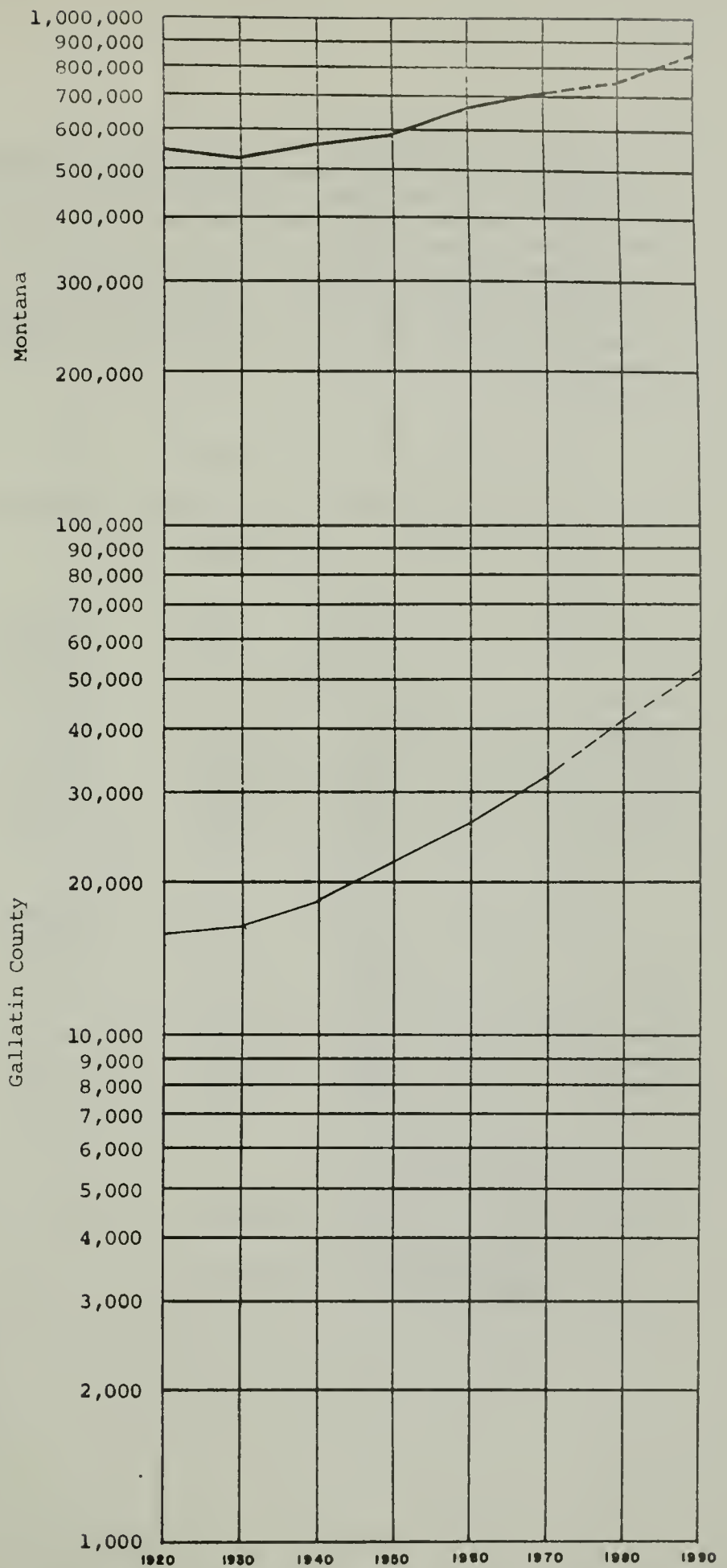
The number of persons in the county has continued to increase over the past fifty years. Growth even occurred during the depression and drought years of the 1930's when many counties in the state lost population. The estimated 1970 population is about fifty percent larger than it was in 1920. Growth during the next twenty years will be substantial due to the increasing size of Montana State University in Bozeman and the expanded recreational development throughout the county.

The county was classified as a remi rural area in 1960 containing at least one incorporated city of 2,500 or more persons and not being included in or near a Standard Metropolitan Statistical Area. Table 1 shows the 1950 to 1970 growth for the urban, farm, and rural non farm populations. As indicated, the urban population has grown at a rate higher than for the rural segment even though substantial growth

CHART 3

COMPARATIVE POPULATION TRENDS

Gallatin County and
Montana



Sources:

1. U.S. Census of Population
2. Intermountain Planners, Inc.

occurred within both categories. Growth within the latter category was entered in the rural non farm areas while the number of persons on farms actually decreased. Over the twenty year period the urban population has continued to represent the major share of the total. The present estimate indicates that two out of every three persons in the county reside within an incorporated town. In 1950 one fifth of all persons lived on a farm. At present, figures indicate a drop to one tenth living there. The rural non farm population represented sixteen percent of the 1950 total but in 1970 increased to twenty four percent.

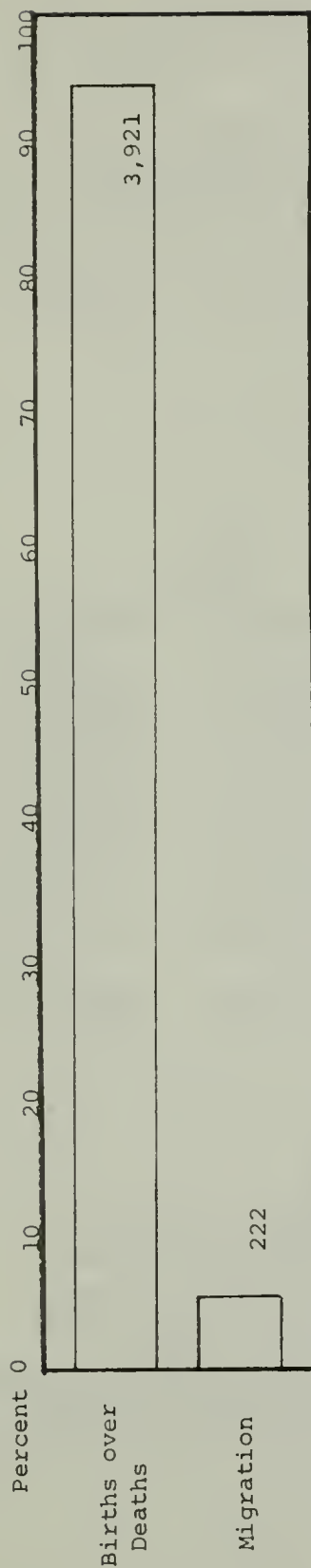
TABLE 1
Urban-Rural Population Changes for Gallatin County
1950-1970

	<u>1950</u>	<u>1960</u>	<u>Changes</u> <u>Number</u>	<u>1950-1960</u> <u>Percent</u>
Total	21,902	26,045	+4,143	+18.9
Urban				
(Inc. Towns)	13,818	16,468	+2,650	+19.2
Rural	8,084	9,577	+1,493	+18.5
Farm	4,675	3,829	- 846	-18.1
Non Farm	3,409	5,748	+2,339	+68.6
	<u>1960</u>	<u>1970</u>	<u>Changes</u> <u>Number</u>	<u>1960-1970</u> <u>Percent</u>
Total	26,045	32,000	+5,955	+22.7
Urban				
(Inc. Towns)	16,468	21,150	+4,682	+28.4
Rural	9,577	10,850	+1,273	+13.3
Farm	3,829	3,150	- 679	-17.7
Non Farm	5,748	7,700	+1,952	+34.0

Sources: 1. U. S. Census of Population
2. Intermountain Planners, Inc.

CHART 4

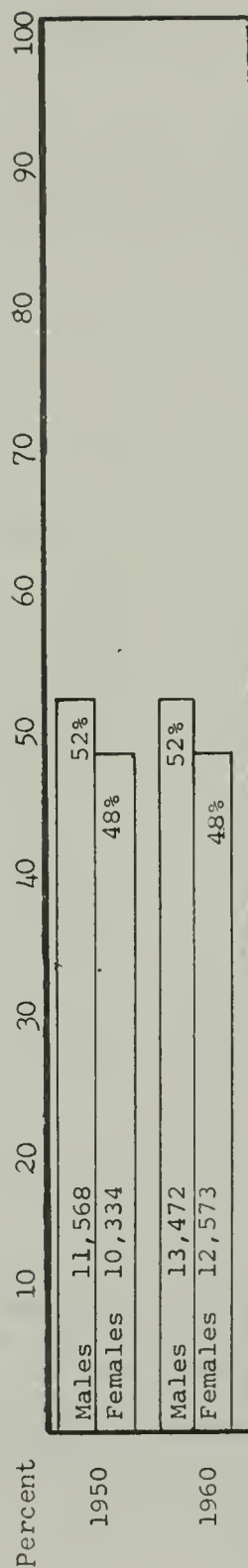
Population Gain
Gallatin County 1950 - 1960



Source: Net Migration of Population, 1950-1960 by Age, Sex, and Color,
U. S. Department of Agriculture

CHART 5

Population by Sex
Gallatin County 1950 - 1960



Source: U. S. Census of Population, 1950-1960

From 1950 to 1960 the number of persons in the county increased by 4,143. Chart 4 indicates that the growth resulted from an excess of 3,921 births over deaths and a net migration gain of 222 persons.

The change in sex composition from 1950 to 1960 is shown in Chart 5. As indicated, the ratio between males and females remained constant with a slight preponderance of males over females. The ratio is expected to remain constant throughout the twenty year planning period.

The age distribution by sex for 1950 and 1960 is shown in Table 2. As indicated, with the exception of ages 25-34 and 55-64 growth occurred within all age groups.

TABLE 2

Age & Sex Composition of Gallatin County

Age Group	1950		1960	
	Male	Female	Male	Female
Under 5	1,255	1,236	1,528	1,498
5-14	1,648	1,539	2,487	2,387
15-19	861	791	1,337	1,280
20-24	1,494	1,050	1,602	1,128
25-34	1,908	1,689	1,715	1,493
35-44	1,365	1,262	1,544	1,549
45-54	1,061	1,040	1,272	1,147
55-64	1,055	897	844	923
65-74	626	533	750	737
75 +	295	297	393	431
Total	11,568	10,334	13,472	12,573

Source: U. S. Census of Population, 1950-1960

A total of twelve towns and communities were studied in Gallatin County. The list includes the four incorporated towns of Belgrade, Manhattan, Three Forks, and West Yellowstone and the eight unincorporated communities of Amsterdam, Bozeman Hot Springs, Central Park, Churchill, Gallatin Gateway, Logan, Maudlow, and Willow Creek. The communities of Anceney, Grayling, Sappington, and Trident were also studied; the first three were not included in this report because of

insufficient population and development, and Trident was excluded because of being a self contained town owned and operated by the Ideal Cement Company.

Because of the amount of time elapsed since the 1960 Census, current population estimates had to be derived from several sources in the field. Surveys and interviews were conducted to determine what now exists and what is expected in the future. Table 3 indicates the past population experience and the future projections for each town and community.

TABLE 3

Population Forecast for Towns and Communities

Gallatin County

	<u>1950</u>	<u>1960</u>	<u>1970</u>	<u>1975</u>	<u>1980</u>	<u>1990</u>
Amsterdam	40	100	100	100	110	130
Belgrade	663	1,057	1,000	1,100	1,200	1,500
Bozeman						
Hot Springs	NA*	NA	350	500	800	1,500
Central Park	NA	NA	20	25	30	50
Churchill	NA	NA	200	220	240	300
Gallatin						
Gateway	160	200	210	200	190	175
Logan	207	200	125	125	115	100
Manhattan	716	889	900	910	920	950
Maudlow	30	20	20	18	15	10
Three Forks	1,114	1,161	1,250	1,300	1,350	1,500
West						
Yellowstone	500	500	500	550	600	750
Willow Creek	85	150	175	170	160	150

*Not Available

Sources: 1. U. S. Census of Population
2. Intermountain Planners, Inc.

The town of Three Forks is the largest urban area in the county included in this report. The number of persons in the town will increase throughout the planning period resulting in a twenty percent increase by 1990. The growth will necessitate an additional eighty homes over the next twenty years. The anticipated development is

expected to occur easterly of the existing town.

Belgrade will have a 1990 population figure similar to that for Three Forks but will have a faster growth rate. The population is expected to increase by half over the next twenty years and require an additional 160 dwelling units. The majority of the homes are expected to be built northeasterly of town with some long range growth occurring in the area southeast of the existing community.

The present population of Manhattan is estimated at nine hundred persons. The twenty year growth rate is expected to be slow resulting in a 1990 population of an additional fifty persons. Most of the growth will be north and west of the community.

West Yellowstone will have a population increase of fifty percent over the next twenty years. An estimated additional eighty homes will be needed to accommodate the expansion and will be built to the west and northwest of the existing town.

The two communities of Churchill and Amsterdam will also experience population growth. Churchill will have a population gain of one third by 1990. New housing to accommodate this growth will occur to the west and southwest of Highway 288.

Amsterdam will have a thirty percent population gain by 1990. The growth of thirty people will be absorbed within the existing community.

Bozeman Hot Springs is expected to have a substantial population increase over the next twenty years. The 1970 estimated population of 350 will increase to 1,500 by 1990. About 365 homes will be added in the area to the west and northwest of the community. A slight population gain is expected in Central Park. The addition will be within the existing limits of the community.

The communities of Gallatin Gateway, Logan, Maudlow, and Willow Creek are not expected to have any population growth between now and 1990.

The population figures reflect only those factors and trends for which information is available. New technological advances, new industries, or other unforeseen events may alter these projections. If such an event occurs, the areas affected should be examined in light of the new conditions.

Housing

In 1960 there were 9,074 housing units within Gallatin County. Chart 6

indicates that almost half were of the urban type while forty one percent were classified as rural non farm. The remainder were represented by farms. The majority of all urban homes were located in Bozeman. The median housing unit size was 4.50 rooms per unit, and the median household size per occupied unit was 3.15 persons. Of those units, almost half were owner occupied while thirty seven percent were used for rental purposes. Chart 7 indicates that one home in seven was vacant. The condition of housing in 1960 is reflected in Chart 8 which indicates that only three percent were in need of replacement while eighteen percent needed repair. The remainder were classified as sound.

Chart 9 reflects the 1960 status of housing units in terms of source of water, water supply, and method of sewage disposal. For geographical reference, the data shows the status for Gallatin County as a whole and for the urban, rural non farm, and farm areas.

In 1960 almost two thirds of all homes in the county were served by a public water system or by a private company. Those served included almost all homes in the urban areas, just over one third of the rural non farm homes, and only three percent of the farms. Generally, the farms relied on individual wells for water as did almost half of the rural non farm homes. Only nine percent of the homes obtained water from another source.

HOUSING Gallatin County

Chart 6
Housing Classification

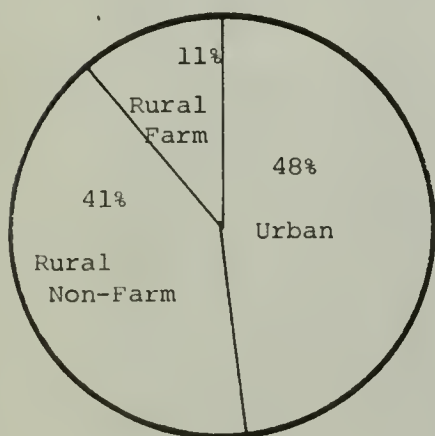


Chart 7
Housing Tenure

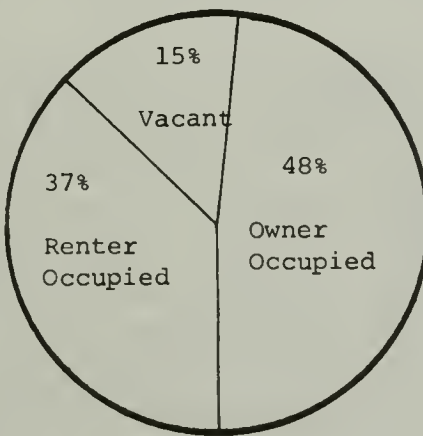
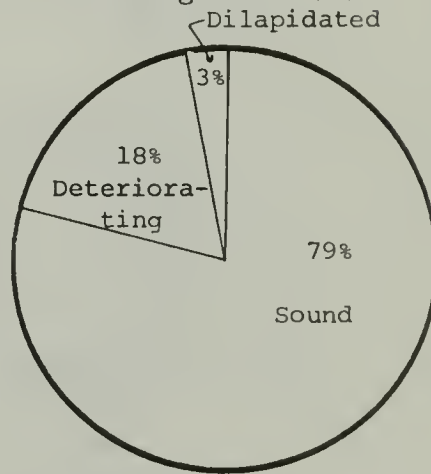
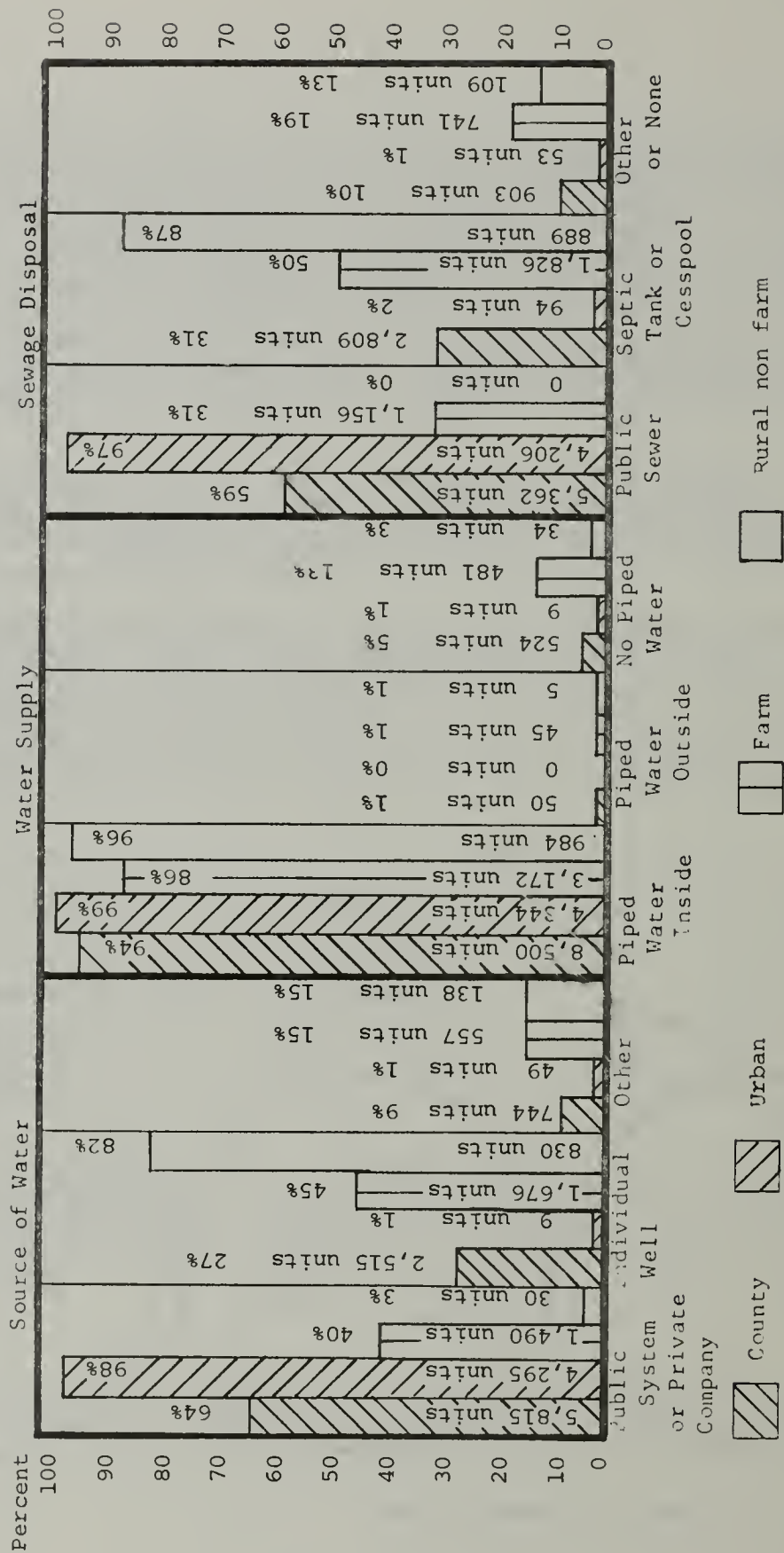


Chart 8
Housing Condition



Source: U. S. Census of Housing, 1960

CHART 9
Sewer and Water
Gallatin County 1960



Source: U. S. Census of Housing, 1960

Almost all homes had piped water in 1960. Only five percent, mainly of the rural non farm type, did not have any piped water at all.

Just over half of the homes disposed of sewage through a public system. This group included almost all the urban homes and about one third of the rural non farm homes. Half of the farms and the rural non farm homes used either a septic tank or a cesspool for sewage disposal. One home in ten, which included nineteen percent of the rural non farm homes and thirteen percent of the farms, relied on a method other than a public system, septic tank, or cesspool.

The housing data indicates that adequate facilities were available in the urban areas in 1960; the rural non farm areas, however, generally were lacking in adequate coverage of either a public water or sewer system.

THE ECONOMY

Labor

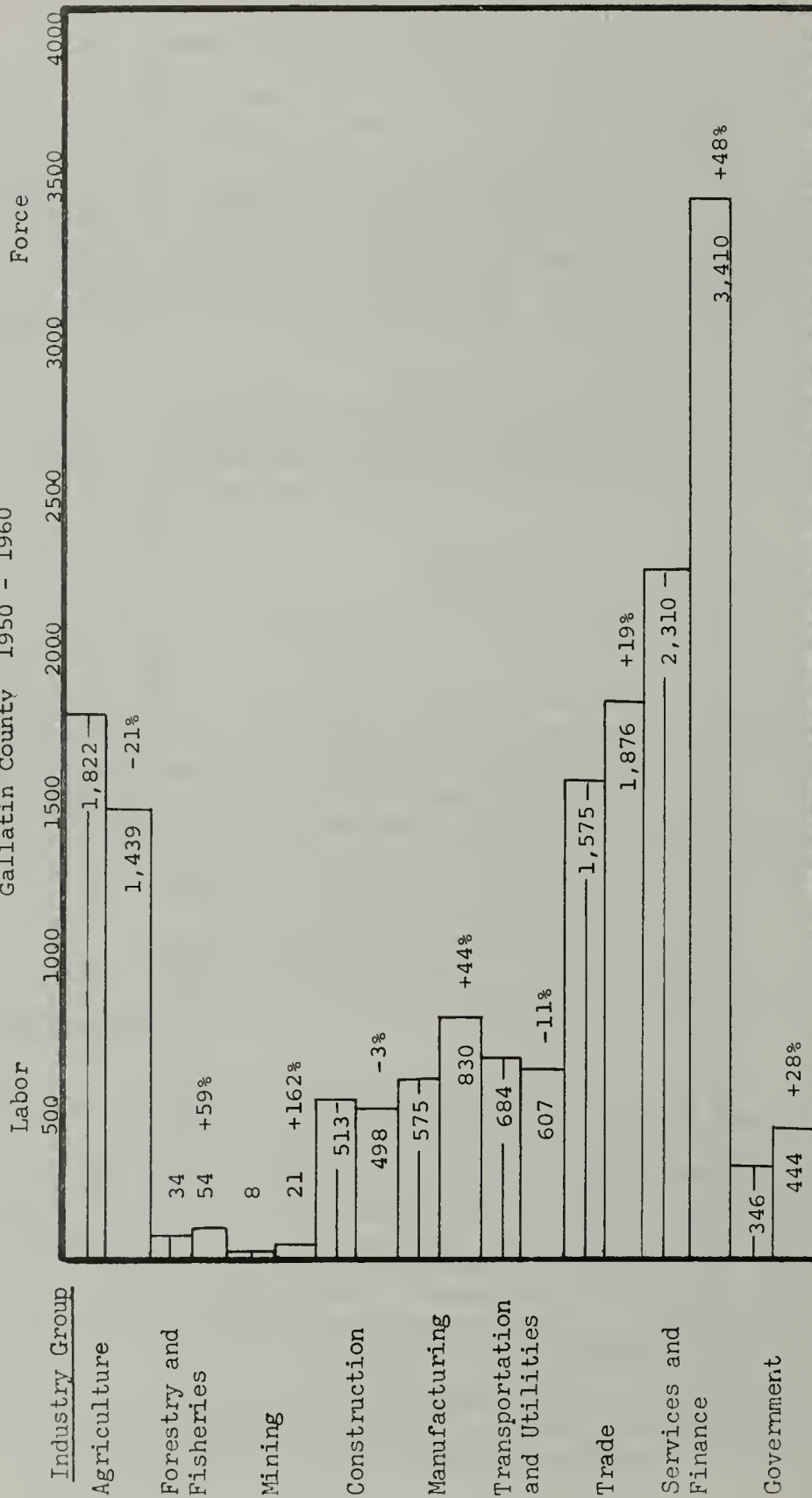
People have a direct relationship on the economy of an area because of their role as both producers and consumers of goods and services. The following economic analysis of Gallatin County is concerned primarily with the total economic spectrum and how it may affect the future of the area. Changing economic conditions can have either a good or a bad effect in terms of population growth, ability to provide for public improvements, or in determining the general overall living environment.

Gallatin County recorded a seventeen percent increase in employment and a nineteen percent population gain between 1950 and 1960. The employment is contrasted with a six percent increase for Montana in the same period.

The past employment change by major industry groups is shown in Chart 10. With the exception of the transportation and utilities, agriculture, and construction groups, all industrial classifications shared in a significant employment gain. The majority of jobs lost occurred within the agricultural group and most job gains were in the services and finance group. Service operations increased significantly in relative importance with much of the gain attributable to the growth of Montana State College in Bozeman. Since a large portion of the new jobs were in female oriented occupations, women enhanced their significance in the total labor force.

Bozeman represents the shopping and services center for the county where complete shopping facilities are available. The importance of this is reflected in the employment characteristics of the county.

CHART 10
Employment Change by Major Industry Group
Gallatin County 1950 - 1960



1950 Total Employment 7,993*

1960 Total Employment 9,365*

*Includes Some Industries Not Reported

Source: U. S. Census of Population, 1950-1960

Within the services and finance group, which represented the largest number of employees, almost half were associated with the education profession. One out of ten was employed in personal services while eight percent were represented by professional persons.

Over half of those in the trade industry group were in retail sales, emphasizing the shopping importance of Bozeman. One worker in seven was engaged in wholesale trade while one in five worked in either bars or restaurants.

TABLE 4
Percent of Total Employment by Industry Groups
Gallatin County, Montana and United States
1960

	<u>Gallatin County</u>	<u>Montana</u>	<u>United States</u>
Agriculture	16	17	11
Forestry and Fisheries	1	1	1
Mining	1	3	1
Construction	5	7	5
Manufacturing	9	10	27
Transportation and Utilities	6	9	7
Trade	20	21	19
Service and Finance	37	26	16
Government	5	6	13
Total	100	100	100

Source: U. S. Census of Population, 1960

The manufacturing industry group attracted 830 workers in 1960. The lumber products phase represented thirty percent of the total as did food processing firms. One worker in four produced durable good items while one in fourteen was employed in the printing and publishing field.

Percentages for employment by industry group, as shown in Table 4, give an insight into local employment characteristics. The table shows the relative weight of each industry group in the county and offers a comparison with that existing in 1960 for the State of Montana and the United States.

The services and finance group attracted the largest percent of the labor force in 1960. Over one third of all workers were represented by that group as opposed to one in four for Montana and one in six for the nation.

One fifth of all employment occurred within the trade industry group. That figure is similar to those for the state and the nation.

Agricultural employment was at a level similar to that for the state with sixteen percent of the labor force represented. The figure is somewhat higher than the eleven percent noted for the United States.

Labor statistics published by the Employment Security Commission of Montana indicate a general increase in activity in 1969 over that nine years earlier. The figures indicate a stabilizing process after the rapid increases of the 1950 to 1960 period.

Continued growth appears certain for Gallatin County. Service and trade occupations will probably lead the way due to the college and the proximity of Yellowstone Park. The Big Sky development and other proposed recreational facilities will also increase the need for additional services. Manufacturing may also grow if the lumber and wood products industry expands.

Agriculture

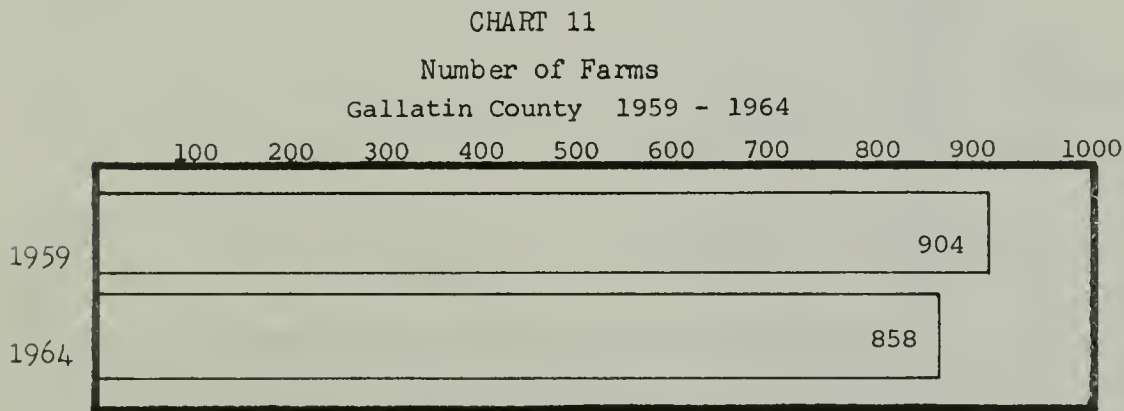
A farm is defined in the United States Census as a place having at least ten acres of land devoted to agriculture and selling at least fifty dollars worth of agricultural products annually. According to Chart 11, there were 858 farms in Gallatin County in the above category in 1964, or five percent fewer than there were in 1959.

The 1964 classification of farms by type was as follows:

Field crop farms other than vegetables, nuts, and fruit		200
Cash grain	189	
Other field crops	11	
Poultry farms		7
Dairy farms		100
Livestock farms other than poultry and dairy		268
General farms		93
Miscellaneous and unclassified		190
Total		858

Of the total number of farms, 120 were classified as part time and forty seven were classified as being operated by semi retired persons.

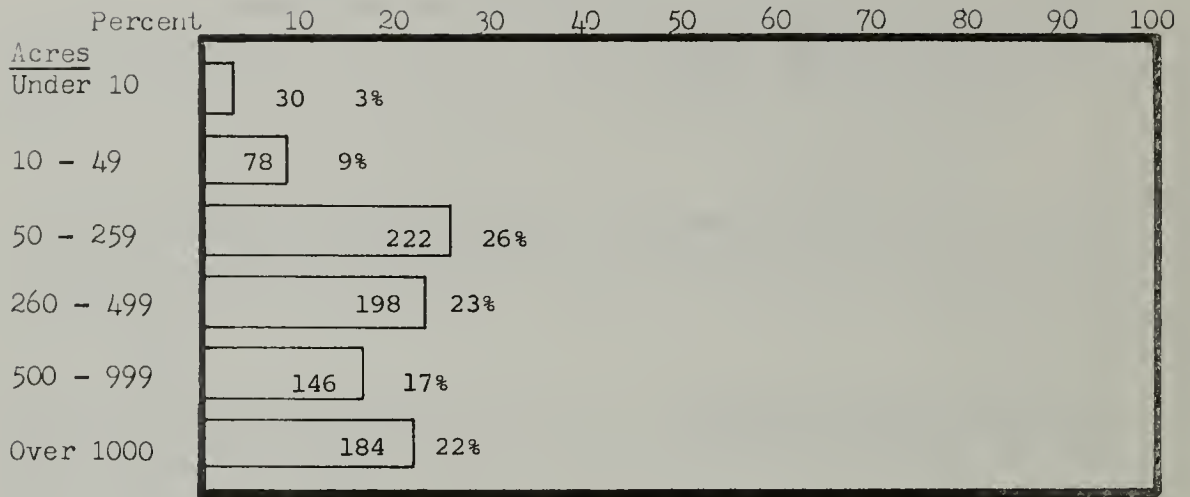
The average size farm in 1964 was 1,179 acres and almost one third were livestock producers. In that year one farm in five raised field



Source: U. S. Census of Agriculture, 1964

CHART 12

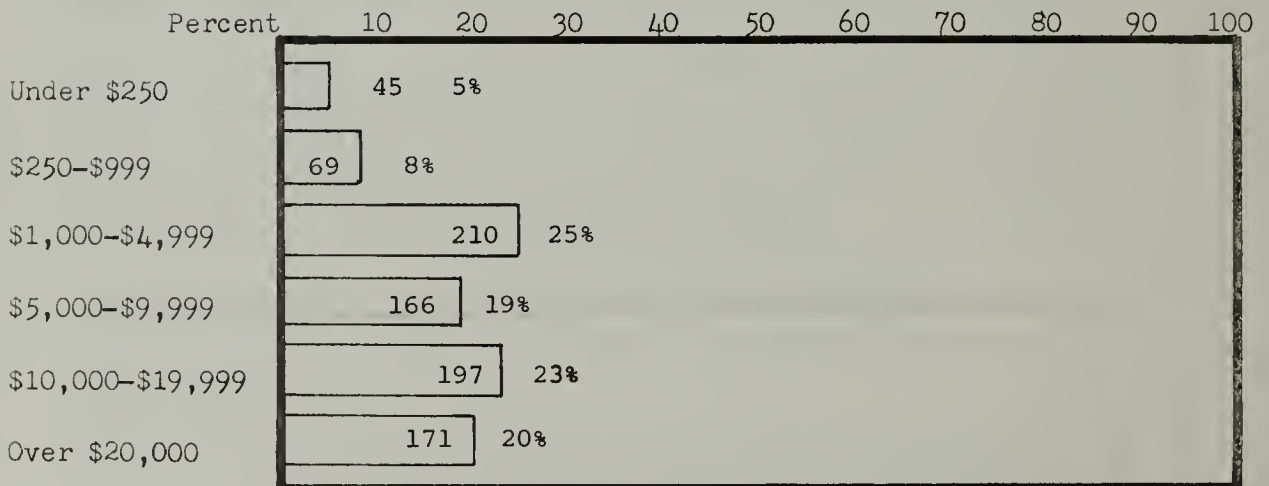
Farms by Size
Gallatin County 1964



Source: U. S. Census of Agriculture, 1964

CHART 13

Number of Farms by Value of Farm Products Sold
Gallatin County 1964



Source: U. S. Census of Agriculture, 1964

crops and a similar number were miscellaneous and unclassified. One in eight specialized in dairy production. Chart 12 indicates that just more than one fifth of the farms were over one thousand acres in size while almost two thirds were under five hundred acres.

The value of products sold by the number of farms is shown in Chart 13. Just less than half of all farms reported sales in excess of \$10,000 while one in five received more than \$20,000 for products sold. More than one third received under \$5,000 for that year.

Cash receipts data for the county from 1964 to 1967 is as follows:

<u>Year</u>	<u>Livestock</u>	<u>Crops</u>	<u>Total</u>
1964	\$7,250,700	\$4,630,100	\$11,880,800
1965	\$8,208,500	\$5,111,700	\$13,320,200
1966	\$9,678,600	\$5,237,500	\$14,916,100
1967	\$9,037,400	\$5,456,000	\$14,493,400

In 1964 the sale of livestock products represented almost two thirds of all agricultural products sold. Throughout the four year reporting period the predominance of livestock sales to crop sales remained the same.

Throughout the planning period the agriculture industry will not have any drastic changes; although, the number of farms may decrease through consolidation and through land conversion to recreation facilities.

THE GOVERNMENT

Before any meaningful consideration can be given to major capital improvement projects, it is necessary to study the governmental organizations in Gallatin County and to analyze their economic structure. At present there are five separate, local governmental units in the county involved within the scope of the water and sewer study. Included are the incorporated cities of Belgrade, Manhattan, Three Forks, and West Yellowstone and the government of Gallatin County.

A Board of County Commissioners presided over by a chairman governs the county. The four incorporated municipalities are governed by a mayor council form of government.

In financing capital improvement projects, the incorporated municipalities have power to bond and raise the necessary moneys for funding projects. The unincorporated small towns do not have similar power and, therefore, must rely on financing projects through the county

government.

Table 5 indicates the financial conditions of each unit of government in 1969.

TABLE 5

Financial Status of County Government and Incorporated Cities

Gallatin County 1969*

	<u>Revenue</u>	<u>Expenditures</u>	<u>Assessed Valuation</u>
Gallatin County	\$11,013,983.03	\$10,536,956.22	\$101,242,332.00
Belgrade	68,723.31	65,879.86	2,251,154.00
Manhattan	83,735.36	83,604.57	1,924,088.00
Three Forks	72,409.94	66,264.36	2,681,831.00
West Yellowstone	118,287.74	109,774.87	3,946,156.00

* There are several methods presently available to communities for financing water and sewer systems:

1. Incorporated Cities and Towns may use Municipal Bonds, Municipal Revenue Bonds, and Special Improvement District Bonds.
2. Unincorporated Towns may use Rural Special Improvement District Bonds and County Water and Sewer District Bonds.
3. Incorporated Cities and Towns and adjacent unincorporated areas may use Metropolitan Sewer District Bonds.

Source: Information received from each governmental unit.

THE WATER RESOURCES

General

The water resources of any area are one of its most important assets.

Montana is fortunate in that water is in abundant supply over much of the state. This is especially true in the mountain areas and along the major drainages. Water is essential for many human needs with individual consumption and sanitation being foremost. Industrial and agricultural uses of water are perhaps next most important. The recreational use of water has also become a significant factor in modern day living.

In his use of this resource, man in the past has polluted much of the available fresh water and degraded it to the point where it is unfit for many or all uses. Careful planning for the efficient use of water resources can avert inconveniences caused by pollution.

Water resources, therefore, are an important consideration in the comprehensive planning for community water and sewer system. In the following portion of this report, the existing water resources of the planning area will be briefly reviewed. The discussion will be specifically concerned with the occurrence and availability of both surface and ground water. Also important, and included in Appendix I, are the specific laws and policies of the State of Montana concerning surface and ground-water resources. "Water Quality Criteria," "Water Use Classifications," and "Policy Statements" adopted by the State Department of Health are discussed in detail. Table A in Appendix I outlines present day water quality standards as set forth by the United States Health Service.

Surface-Water Resources

Gallatin County has an extensive drainage system which has primary characteristics of mountainous topography. The county is surrounded by mountainous terrain with four mountain ranges predominating. A portion of the Big Belt Mountains occupies the extreme northern portion of the county, the Bridger Range occurs in the northwestern corner of the county, and portions of the Gallatin and Madison Ranges occupy the southern half of the county. The mountainous portions of the county are also heavily timbered while the Gallatin and Madison River drainages of northwestern Gallatin County are the major timber free areas.

The wide variation in elevations add to the complex surface drainage system. Elevations in excess of ten thousand feet above sea level occur in the Madison and Gallatin Ranges in southern Gallatin County, and an elevation of over 9,600 feet occurs on Sacajawea Peak in the Bridger Range in northwestern Gallatin County. The lowest elevation in the county occurs where the Gallatin and Madison Rivers flow together at Three Forks in extreme western Gallatin County. The elevation at this point is just over four thousand feet above sea

level.

Many streams and rivers make up the complex drainage system for the county. Major streams making up the system are the Gallatin River, the East Gallatin River, and the Madison River. The Gallatin and Madison Rivers join the Jefferson River near Three Forks in Gallatin County to form the headwaters of the Missouri River. The Missouri River flows northeast and forms the county line between Gallatin and Broadwater Counties for over fifteen miles before turning northwest and flowing into Broadwater County south of Townsend. Except for a small portion of Gallatin County east of the Bridger and Gallatin Ranges which drains into the Yellowstone River drainage, all the drainage from Gallatin County is received by the Madison and Gallatin River drainages. The Madison River heads in Yellowstone National Park and flows north through Madison County before entering Gallatin County south of Three Forks. Just over twenty miles of the Madison River drainage are located in Gallatin County. The Gallatin River also heads in Yellowstone National Park in southern Gallatin County and flows in a northerly direction through the county to a point west of Belgrade where it swings westerly to join the Madison River at Three Forks. The East Gallatin River heads just northeast of Bozeman and flows in a northwesterly direction to its confluence with the Gallatin River near Manhattan.

The above mentioned streams and their tributaries provide a yearlong source of water for irrigation, livestock, and domestic needs. Many of these streams have gaging stations installed by the United States Geological Survey where measurements are taken and recorded at regular intervals. Table 6 includes available data on the drainage area, discharge, and runoff for each gaging station pertinent to Gallatin County.

Several reservoirs provide water storage for various uses. The largest storage facility is Hebgen Lake in extreme southern Gallatin County. Water is stored in this reservoir for the purposes of power generation by the Montana Power Company. Two reservoirs, one in Gallatin County and one in Madison County, are utilized for the purposes of irrigation within Gallatin County. The largest of these is the Willow Creek Reservoir located just east of Harrison in extreme northeastern Madison County. The storage capacity of the reservoir is 17,760 acre feet with a flooded area totaling 868 acres. Water stored by the Willow Creek storage reservoir will furnish a supplemental supply for irrigation of twelve thousand acres of land along the Willow Creek Valley in Madison and Gallatin Counties. The second irrigation reservoir is the Middle Creek, or Hyalite Creek, Reservoir located in the Gallatin Range southeast of Bozeman. Storage capacity of the reservoir is 8,027 acre feet, and the total flooded area is 248 acres. Water stored in the Hyalite Creek Reservoir is used to supplement the

Stream	Gaging Sta. Location	Drainage Area (sq mi)	Max.	Date	Min.	Date	Average	Max.	Date	Mine.	Date
11. Bridger Creek	Near Bozeman	*	1	776	5/22/48	2.7	9/1/49	*	*	*	*
12. Hyalite Creek	Near Bozeman	45	2	956	6/14/98	0.4	2/2/39	56.9	*	*	*
13. Bangtail Creek	Near Chadbourne	*	1,3	88	6/23	1.5	6/23	*	*	*	*
14. Brackett Creek	Near its Mouth	*	1	1,400	5/22/48	0.6	12/27/43	27.5	*	*	*

Source: "Water Resources Survey" Gallatin County, Montana,
Montana Water Resources Board, Helena, Montana 1953

- Notes:
1. Irrigation diversions occur above these stations
 2. Flow is regulated by one or more reservoirs
 3. Only short term or seasonal records available

water supply for irrigation in the Gallatin Valley. The Montana Water Resources Board has published a list of information for those reservoirs, both publicly and privately owned, which contain fifty acre feet or more of water. Complete information concerning irrigation facilities in Gallatin County may be found in the "Water Resources Survey" published by the Montana Water Resources Board in January, 1953. Also, current information may be obtained from the Water Resources Board in Helena, Montana.

The climate varies considerably from one area to another because of the range of topographic conditions. The effect that topography has on the climate is very important to the water resources of the county. Prevailing west to southwest winds flowing across the high mountains provide the highest annual precipitation values, whereas the valley portions of the county experience much lower values. As an example of the net effect of these conditions, a precipitation measuring station at Trident along the Missouri River northeast of Three Forks recorded a fourteen year annual precipitation average of 12.28 inches. A precipitation measuring station at Hebgen Dam, on the other hand, recorded a forty eight year average annual precipitation value of 23.42 inches. Indications are that the high mountains of the Bridger Range and the Gallatin and Madison Ranges receive even greater annual precipitation amounts.

In general, precipitation occurs as steady rain in the spring months of April through June, intermittent showers throughout the summer and early fall months, and as snowfall in the winter months. The majority of the precipitation in the lower valleys and agricultural areas occurs during the growing season. Precipitation in the mountainous areas is fairly steady throughout the year. Much of the precipitation during the winter months occurs as snowfall, and the resulting heavy snowpack produced in the high mountains each year contributes significantly to the water resources. Snow begins to accumulate in November in the higher mountain valleys and continues to build up until late March or early April. Portions of the high mountain snowpack in Gallatin County and in other adjacent drainage areas remain until the warm temperatures of late July and August begin to melt them. The runoff from the snowpack at this time of the year coincides with the period of maximum demand for water in the valleys below.

The use of surface water is widespread for agricultural and recreational purposes. The "Water Resources Survey" for Gallatin County published by the Montana Water Resources Board in 1953 indicates that at that time nearly 130,000 acres were being irrigated and that a potential existed for the existing facilities to irrigate nearly 27,000 additional acres. A final but important use of surface water is for recreational purposes. The mountain lakes and streams in the county are ideal habitat for fish and waterfowl and draw many fishermen

and hunters to the area each year.

Water Use Classifications

The Water Pollution Control Council has classified the streams and drainages in Montana according to the water use classification definitions shown in Appendix I. The streams and drainages of Gallatin County and surrounding areas are classified as follows:

Missouri River Drainage to the Sun River in Great Falls except tributaries pertinent to Gallatin County listed below:	B-D ₁
East Gallatin River (mainstem) (tributary to the Gallatin River, tributary to the Missouri River) from Montana Highway No. 293 crossing about one half mile north of Bozeman to, but excluding, Dry Creek about five miles east of Manhattan.	B-D ₂
Remainder of the East Gallatin River drainage except the trib- utaries listed below:	B-D ₁
Lyman and Sourdough (Bozeman) Creek drainages to the Bozeman water supply intakes	A-Closed
Remainder of the Lyman and Sourdough Creek drainages	B-D ₁
Hyalite Creek drainage to the Bozeman water supply intake	A-Open-D ₁
Remainder of the Hyalite drainage	B-D ₁

Ground-Water Resources

Ground water is used extensively in Gallatin County for domestic, stock, irrigation, and municipal purposes. As of January 1970, 2,064 well and 566 spring appropriations were on file at the Montana Bureau of Mines and Geology for Gallatin County. The 2,064 wells were divided into the following water use categories: 1,061 domestic,

604 domestic and stock, 194 stock, eighty eight irrigation, thirty one commercial, thirty public supply, twelve industrial, seven institutional, and twenty eight other purposes. Of the 566 springs, 173 were used for stock, seventy for domestic and stock, eighty for irrigation, two for public supply, and three for industrial and commercial purposes. The water use for the remaining 236 was not reported.

The incorporated communities of Belgrade, Manhattan, Three Forks, Trident, and West Yellowstone have appropriated ground water for municipal purposes. (See Table 7 for chemical analyses of these water supplies.) Privately owned wells provide the residents of Amsterdam, Anceney, Gallatin Gateway, Logan, Maudlow, and Willow Creek with water for household, lawn, and garden needs. The city of Bozeman obtains its water supply from reservoirs located on Lyman and Middle Creeks south of the city.

One detailed hydrogeological investigation (Hackett, O. M., and others, 1960, Geology and ground-water resources of the Gallatin Valley, Gallatin County, Montana: U. S. G. S. Water Supply Paper 1482, 282 p.) has been conducted in Gallatin County. This report contains numerous maps, tables, and illustrations in addition to a comprehensive discussion of the water resources of Gallatin Valley and adjacent areas. Other maps and reports containing useful geological information are: (1) Alden, W. C., 1953, Physiography and glacial geology of western Montana and adjacent areas: U. S. G. S. Prof. Paper 78, 271 p.; (2) McMannis, W. J., and Chadwick, R. A., 1964, Geology of the Garnet Mountain quadrangle, Gallatin County, Montana: Montana Bureau of Mines and Geology Bull. 43, 47 p.; (3) Roberts, A. E., 1964, Geologic map of the Mystic Lake quadrangle, Montana: U. S. G. S. Misc. Geol. Inves. Map I-398; and (4) Skipp, Betty, and Peterson, A. D., 1965, Geologic map of the Maudlow quadrangle, southwestern Montana: U. S. G. S. Misc. Geol. Inves. Map I-452.

High mountain ranges separated by alluvial filled valleys characterize Gallatin County. The geological history of the area has been very complex, exposing a wide variety of sediments which vary greatly in age, lithology, thickness, and areal distribution. The occurrence and availability of ground water is directly related to the geological history of the area. This history includes long periods of sedimentation, structural deformation, emplacement of large igneous masses, erosion, and glaciation.

During Precambrian time (over 600 million years ago), thousands of feet of sediments were deposited and later altered by heat and pressure to form metamorphic rocks. These rocks are predominantly gneiss and schist with some argillite (slightly metamorphosed shale) and quartzite and are the oldest exposed in Gallatin County. Overlying the

TABLE 7

Chemical Analysis of Municipal Water Supplies
(All Figures in Milligrams per Liter)*

City or Town	Belgrade			Manhattan			Three Forks				Trident				West Yellowstone	
	City City SW of Park Park Town Well Well Well #1 #2			Springs Well Well #2 #3			Well Well Well Layne #1 #2 #4 Well				Well Well Well Well at #1 #2 #4 Trident Plant				Well	
Date	6/65	6/65	6/65	4/68	4/68	4/68	5/66	5/66	4/68	5/67	5/66	5/66	4/68	5/67	7/53	
Total Solids	258	256	246	225	275	265	392	428	316	380	392	428	316	380	100	
Hardness	230	220	215	175	155	150	286	314	205	291	286	314	205	291	20	
Ca	72	64	62	32	28	48	88	90	42	74	88	90	42	74	6	
Mg	12	15	15	23	27	7	16	22	24	26	16	22	24	26	2	
Na+K	2	2	4	21	30	36	31	42	25	26	31	42	25	26	11	
CO ₃	0	0	0	12	12	11	0	0	9	0	0	0	9	0	0	
HCO ₃	230	220	225	143	89	60	277	322	107	280	277	322	107	280	46	
SO ₄	31	30	31	44	100	106	101	114	114	91	101	114	114	91	12	
Cl	6	5	3	10	18	26	11	13	14	12	11	13	14	12	-	
NO ₃	2.4	1.4	1.8	2.4	0.2	0	1.2	4.2	2.8	3.7	1.2	4.2	2.8	3.7	Trace	
F	0.0	0.0	0.0	0.14	0.2	0.2	0.8	1.0	0.82	0.9	0.8	1.0	0.82	0.9	5	
Fe	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.00	0.0	0.00	0.14	0.00	0.0	0.00	0	
As	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.005	-	-	-	0.005	-	Trace	
Pb	0.01	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	0.004	
Cu	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	0	
Zn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

* See Appendix I, Table A, for accepted water quality standards
Source: State Department of Health, Helena, Montana

Precambrian rocks is another moderately thick sequence of sedimentary rocks (limestone, shale, and sandstone) deposited during Paleozoic (225 million to 600 million years ago) and Mesozoic (65 million to 225 million years ago) time. The entire region including all of Gallatin County was uplifted, faulted, folded, and eroded at the end of Mesozoic time. During the Tertiary Period (one to 65 million years ago), extensive volcanism in the southeastern part of the county capped many of the underlying sediments with a thick mass of volcanic rocks. Continued erosion of the high mountain areas exposed many of the older sedimentary and igneous rocks, while deposition of fine grained sediments of Tertiary age was taking place in the topographic lows, gradually filling the broad structural basins. During Pleistocene time (twenty thousand to one million years ago), numerous valley glaciers scoured out many of the canyons in the Gallatin, Madison, and Bridger Ranges providing large quantities of erosional debris (mainly silt, sand, and gravel) which was deposited along all the major streams and portions of the Gallatin Valley. Continued erosion of the high areas and deposition along stream flood plains during the past twenty thousand years (Recent age) has developed the present day landscape.

The most important aquifers (water bearing strata) in Gallatin County are: (1) Precambrian metamorphic rocks; (2) Paleozoic and Mesozoic sedimentary rocks; (3) Tertiary volcanic rocks; (4) Tertiary basin fill; (5) Pleistocene sedimentary deposits; and (6) Recent alluvial flood plain deposits.

Precambrian metamorphic rocks consisting of gneiss and schist of the Pony and Cherry Creek Series underlie large areas of the Gallatin, Madison, and Bridger Ranges. Overlying the Pony and Cherry Creek Series is a thick sequence of younger, slightly metamorphosed, Precambrian rocks of the Belt Group. The Belt sediments are primarily located in the northern part of the county and are predominantly argillite with some quartzite. All the Precambrian rocks are tightly compacted and exhibit very low permeability (ability to transmit water); consequently, only small quantities of water, one to five gallons per minute (gpm), can be expected from wells drilled into these rocks. Slightly larger yields, five to twenty gpm, can be anticipated if extensive fractured and/or weathered zones adjacent to major fault zones can be encountered. Water obtained from Precambrian rocks is generally excellent in quality.

Along the foothills of the mountains are tightly folded and faulted rocks of Paleozoic and Mesozoic age. The Flathead Sandstone, Madison Limestone, Swift Sandstone, and Kootenai Sandstone are all potential water producing formations. These units, particularly the Madison Limestone, are the source of numerous springs in the mountain areas. Properly located wells can probably obtain three to forty gpm from these units. The Madison Limestone may locally yield more water to

wells if extensive cavernous zones are encountered near the top of the formation. Tertiary volcanic rocks underlie the southeastern quarter of the county. Little is known about the water bearing capabilities of these deposits; however, properly located wells will likely yield one to five gpm of good quality water. Precipitation is the primary source of recharge rocks of Precambrian, Paleozoic, and Mesozoic age as well as the volcanic rocks of Tertiary age.

The Gallatin, Madison, and Jefferson Valleys contain an unknown thickness of Tertiary basin fill deposits consisting of sand, silt, clay, and volcanic ash derived from erosion of nearby mountain areas. Several test wells located in the center of the Gallatin Valley have penetrated at least sixteen hundred feet of Tertiary sediments. Geophysical data suggest that the basin fill may be as much as twelve thousand feet thick. In general, the Tertiary sediments are poor aquifers; however, small quantities of water adequate for domestic and stock use are commonly obtained from wells no more than two hundred feet deep. The water is likely to be somewhat mineralized. Tertiary sediments are recharged by infiltration of streams and irrigation waters.

Extensive outwash deposits of Pleistocene age are present along the major streams and portions of the Gallatin Valley. The outwash deposits vary from a few feet thick to over one hundred feet thick and are composed of coarse sand and gravel with a few lenses of silt and clay. If these sediments are fairly thick and saturated, they are capable of yielding large quantities of water, over one thousand gpm, to wells. A number of high capacity irrigation and municipal wells penetrate this aquifer. The water is generally excellent in quality.

Alluvial flood plain deposits of Recent age are located along all the major streams and smaller tributaries in Gallatin County. Wells located in this material are commonly fifteen to sixty feet deep and yield twenty to five hundred gpm. Yields in excess of one thousand gpm can be expected from properly constructed wells located along the major streams where the alluvium is thickest. The water is excellent in quality; however, it can be contaminated by nearby surface-water sources. Both the outwash deposits and the alluvial flood plain sediments are recharged by nearby streams and seepage of irrigation water.

In summary, the principal aquifers of the county are the Tertiary basin fill, Pleistocene outwash, and Recent alluvial deposits, and they are still relatively undeveloped. The outwash and alluvial aquifers are capable of yielding large quantities of water for irrigation, industrial, commercial, and municipal purposes. Care should be taken not to contaminate these aquifers in the future. Additional hydrogeological investigations will undoubtedly be needed to assist in future

development of Gallatin County's water resources.

- Sources:
1. M. K. Botz, Montana Bureau of Mines and Geology, Butte, Montana, 1970
 2. State Department of Health, Helena, Montana
 3. "Water Resources Survey," Gallatin County, Montana Montana Water Resources Board, Helena, Montana, 1953

THE SOILS

General

General descriptions of soils in specific areas are useful in predicting the potential problems which might be encountered during private and public works construction. Gallatin County has an interesting and complex geological history which has influenced the soil structure of the area. The dominate physiographic features of the county are the narrow canyons and broad stream valleys bordered by high mountain ranges.

Some local mountain glaciation has occurred in the geologic past, and before and since that time erosion has continued to reshape the various existing land forms. Also, extensive drainage throughout the area over periods of time has resulted in the filling of the stream valleys and drainage basins with alluvium. The soils of Gallatin County are made up of the alterations of the alluvium and other geologic parent materials of the nearby mountains due to various conditions of climate, topography, and living organisms.

Soil Map

The Soil Conservation Service of the United States Department of Agriculture has prepared a general soil map for Gallatin County. The map as presented by them is shown in this report as Map 4. In developing this map, the Soil Conservation Service made field studies and observations which resulted in the designation of six general soil areas. Each general soil area, as a rule, contains a few major and several minor soils. Soils within an area may differ greatly in short distances, and any one soil may occur in more than one area. Thus, the general soil map does not show the kind of soil at any particular point but shows specific patterns of soils.

The Soil Conservation Service is continuing its detailed study of the

soils of Gallatin County. Information regarding specific areas is available from the Soil Conservation Service office in Bozeman, and it is recommended that all available data be utilized in the planning of public works projects. In addition, on site soil investigations for specific projects provide invaluable information.

The Soil Conservation Service descriptions of the six general soil areas shown on the general soil map are presented as follows:

1. These are areas dominated by shallow to deep, well to poorly drained, loam and clay loam soils of the alluvial valleys and low terraces. Included are small areas of very wet soils and marshland.

2. These are areas dominated by deep and moderately deep, light to dark colored silty and loamy soils with high lime content. These soils are on nearly level to rolling benches and fans. Included are small areas of wet soils in narrow valleys and shallow soils on bedrock or over gravel.

3. These are areas dominated by deep and moderately deep, dark colored to black, loam and clay loam soils. These soils are on level to steep benches and rolling to steep hilly uplands. Included are small areas of wet soils in narrow valleys and shallow soils on bedrock or over gravel.

4. These are areas dominated by shallow to moderately deep, well drained, light colored to black, gravelly sandy loam soils. These grassland and forested soils are on nearly level to rolling benches of high mountain valleys. Included are small areas of wet soils and marshland.

5. These are areas dominated by shallow to deep, well drained, grassland soils of the hilly and steep bedrock uplands. Included are areas with scattered trees.

6. These are areas dominated by shallow to deep, well drained, forested soils of the mountains. Included are areas of grassland soils.

Conclusions

The soils of Gallatin County have generally been easy to deal with where shallow domestic water wells and individual sewage drainfields have been constructed. The alluvium and other surface soil deposits have been found to be extremely variable in permeability, however. This has an effect on both the quantity of water available in shallow domestic wells and the successful operation of individual sewage

drainfields. Also, the presence of a high ground-water table in many valley bottoms and stream drainages causes poor subsurface drainage conditions.

Construction of municipal water and sewer systems in the various soils of Gallatin County has not been difficult. Pipeline trench digging in the sands and clays is extremely easy while the coarse gravels slow operations somewhat. Bedrock at shallow depths is not common in the valley bottoms; however, it can be expected at normal water and sewer line installation depths at specific isolated spots at the toe of mountain slopes. Detailed soil information should be obtained before project planning and construction cost estimating are begun.

Source: U. S. Department of Agriculture, Soil Conservation Service, Bozeman, Montana

COMMUNITY WATER SYSTEM FACILITIES

General

This comprehensive report covers the overall problems, existing or projected, for Gallatin County, Montana. The volume of data processed and evaluated and the intent of the report allow only a general analysis of any one system.

The intent of this report is to point out the general needs of each community with the objective that each community may in the future be provided with a safe and adequate water system. The general solutions to overall problems suggested in this report may have to be modified when detailed studies are made. These modifications may be in exact size of parts of a system or in some detailed design variation but will not detract from the overall value of the general information presented.

Basically, the demand for water from community systems is for domestic, fire fighting, and industrial uses. The demand for industrial water supply in small communities has not been extensive in Montana and in most cases will not control the design of community systems. Sufficient water for fire fighting must be considered; however, economic feasibility will usually control the extent of such facilities. In most small communities a system with sufficient capacity to give high ratings for fire protection would require facilities considerably larger than necessary for domestic purposes. The community might be unable to finance such an improvement; the approach, therefore, has been to propose a system suitable for present domestic needs. These basic facilities can be expanded for more complete service and for

higher fire ratings as it becomes economically feasible.

The domestic use of water has increased greatly in recent years. This is partially due to improved economic conditions which make it possible for families to acquire such water consuming appliances as dishwashers, waste disposal units, and automatic washing machines. Water use for beautifying property has also increased. The most essential condition is adequate, safe, and potable water for domestic purposes, and this has been the primary consideration in this study. Appendix II contains further information on analysis criteria.

Basic Considerations

Communities studied in this comprehensive plan were those with a minimum of five potential users and a maximum population of 5,500. Each community within this category was visited at least once. During these visits the type of water facilities available was examined, and an evaluation of the facilities was made from the standpoint of fulfilling the needs of the residents.

The existing systems were found to be quite varied in their operation, condition, and suitability for serving the needs of the users. The situation in each community was evaluated separately; however, some general classification of the various systems was possible. These are described briefly in the following paragraphs so that the general philosophy of the analysis can be shown.

1. In some communities the homes are quite widespread and few in number. Good water in adequate quantities can be found at reasonable depths, and for such situations, private wells will provide a safe and suitable water system.

2. Many communities have had access to good water from private wells for many years. In some of these communities population is increasing, and the area is becoming more densely settled. As a result, tests for bacteriological quality of well water occasionally indicate that pollution is present. When this occurs, it is usually the beginning of a problem which will continue to worsen. Increasing population and a higher potential for contamination indicate the need for a safe community water facility. The system should be one which will serve the domestic needs of the present residents with provisions for improvements and expansion as needed.

3. Many communities have enjoyed a central water system for years but have not made annual improvements and replacements. This has resulted in overloaded and antiquated systems. Suggestions for immediate improvements which will fit into an overall replacement

program are included in this report.

4. Some communities which have experienced a steady population growth are finding that their water systems are inadequate for present demands and will require enlargement. Population projections and economic trends are used to determine the need for improvements and also to justify the type and extent of proposed improvements.

Gallatin County

The estimated 1970 population of Gallatin County is 32,000. Approximately eighteen thousand, or fifty seven percent of these people, are presently served by central water systems, and the remainder are served by such private facilities as wells and springs. By 1980 about 26,000, or sixty four percent of the population, will have access to central water systems if the schedule of proposed improvements is followed. It is expected that the remaining thirty six percent will live in outlying areas, and the homes will not be close enough together to make central systems feasible.

Three Forks

Existing System. The estimated 1970 population is 1,250. Population projections indicate that the town will show substantial increase throughout the planning period. A central water system presently serves the town, and the layout is shown on Map 5.

Water supply is obtained from three wells. The combined capacity of these wells is 1,175 gallons per minute (gpm). There is higher than normal per capita water consumption in this community; however, the existing well yield is reportedly adequate. A ten inch supply line connects two of the wells to the distribution system. This line has adequate capacity but is reportedly in poor condition and will require replacement during the planning period. The distribution system consists of four, six, and eight inch diameter water mains which provide adequate flows and pressures throughout the town. All of the distribution system consists of cast iron pipe. Electrolysis is causing deterioration of the distribution piping causing a continual maintenance problem. Storage facilities presently consist of a 250,000 gallon tank located one mile southeast of town. This storage facility has adequate capacity for the present and future needs of the community.

Improvements Next Five to Ten Years. By 1975 the population is expected to be thirteen hundred. It will be necessary to begin replacing the ten inch supply line during this period. This

improvement can be combined with an annual maintenance program whereby a portion of the line is replaced each year. The type of pipe which is used for this replacement should be one which is not affected by electrolysis. Much of the distribution piping will have to be replaced, and this improvement can be conducted on an as needed basis.

Improvements by 1990. For 1990 the population is expected to be fifteen hundred. The existing system together with the improvements proposed under the five to ten year plan will provide a facility which is adequate for the needs of this population. Expansion of the distribution system into new areas of development will be necessary throughout the entire planning period. The existing system has sufficient capacity to supply these new areas of development. Minor repair and replacement will continue to be required through 1990.

Belgrade

Existing System. The 1970 population for Belgrade is estimated to be one thousand. Population projections indicate that the town will show substantial population increase throughout the planning period. A central water system is in operation, and the layout is shown on Map 6.

Water supply is presently obtained from three wells with a combined capacity of fifteen hundred gpm. There is high water usage in the town; however, this well yield is reportedly adequate. The distribution system consists of four and six inch cast iron water main. They provide adequate flows and pressures for domestic purposes. Storage presently consists of a 100,000 gallon tank which is slightly undersized for the present population. The population growth which is expected to take place during the planning period will necessitate enlarging and expanding the existing water system.

Improvement Next Five to Ten Years. By 1975 the population is expected to be eleven hundred. The present water system will have to be expanded in several areas to provide suitable service, and the expansion of the distribution system into new areas of development will also be required. This expansion program should involve at least six inch diameter water main laid out in such a pattern that a complete loop is developed. This loop should be connected to the four inch and smaller diameter water mains so that additional flow will be available. If the present high water usage continues, additional well yield may also be required. Wells can be readily obtainable in the area so that if demand develops the yield can be obtained.

Improvements by 1990. For 1990 the population is expected to be fifteen hundred. Expansion of the distribution system will continue to

be necessary during this period. Additional storage facilities will also be required to serve the needs of this population. This facility should be constructed near the site shown on Map 6. Additional well yield may also be required, but again, this is dependent on the continuation of above average water usage. The existing system together with the improvements proposed during the planning period will result in a facility with adequate capacity for the anticipated population.

Manhattan

Existing System. The estimated 1970 population is nine hundred. Population projections indicate that the town will increase slightly in population throughout the planning period. A central water system is in operation, and the layout is shown on Map 7.

Water supply is presently obtained from springs located four miles south of town and from two wells located in the town. The combined capacity of these sources is 1,120 gpm. There is high water usage in the town; however, this water supply is reportedly adequate. Water supply from the springs is transmitted to the town by a fourteen inch wood supply line which reduces to ten inch diameter near the town. The fourteen inch diameter section of line is reportedly in good condition, but the approximately nine thousand feet of ten inch line is in poor condition and will require replacement in the near future. The distribution system consists of six and eight inch diameter water main and provides adequate flows and pressures throughout the system. At the present time there are no storage facilities on the water system.

Improvements Next Five to Ten Years. For 1975 the population is expected to be 910. A water storage tank would be a very worthwhile improvement for the water system, and it is proposed that it be constructed during this period. A 200,000 gallon tank would provide the necessary reserve of water for short periods of high demand. Some expansion of the distribution system into new areas of development will also be necessary. The existing system has sufficient capacity for this expansion. It is reported that water shortage is experienced during high demand periods of the summer. The proposed storage tank would tend to alleviate this shortage; however, it may be necessary to develop additional wells to provide sufficient water for the irrigation season. Ground water is available and could be developed to furnish the required flow. During this period it is proposed that the existing ten inch wooden supply line to the spring site be replaced. This can be accomplished on an as needed basis or the entire line replaced under one project.

Improvements by 1990. By 1990 the population is expected to be 950. The fourteen inch wooden supply line will have deteriorated to the point where replacement may be required. It is proposed that this line be replaced by 1990. The existing system together with the improvements proposed during the planning period will provide a system which is adequate for the needs of the 1990 population. Minor repair and replacement will be necessary throughout the planning period.

West Yellowstone

Existing System. The five hundred permanent residents of this community rely on private wells for water supply. These wells produce adequate quantities of good quality water for each user. The wells range from one hundred to 240 feet in depth. A few wells are very shallow. There is a substantial increase in population during the summer months due to tourist activity in the area. There are many motels and restaurants which use large quantities of water. A community water system is feasible for this community and is necessary for the proper development of the community.

Improvements Next Five to Ten Years. For 1975 the population is expected to be 550. A community water system is proposed during this period, and the layout is shown on Map 8.

Two wells with a combined capacity of 2,500 gpm are proposed to supply the system. This quantity of water could be obtained from properly constructed wells. Storage facilities with a capacity of 750,000 gallons will be necessary on the system. The distribution system should consist of an eight inch circumferential loop with smaller feeder lines providing service to each area of the town. The proposed system has sufficient capacity to provide water for the high demand period associated with the tourist season.

Improvements by 1990. For 1990 the population is expected to be 750. The system as proposed under the five to ten year plan will have sufficient capacity for the needs of the town throughout the entire planning period. Minor repair and replacement will be necessary to keep this system in satisfactory operating condition.

Bozeman Hot Springs

Existing System. At the present time there are 350 persons residing in this community. Private wells are used for water supply and provide an adequate quantity of good quality water to each household. The wells are from thirty to ninety feet in depth. A substantial

population increase is predicted for this area, and at the present time population density is sufficient to warrant the construction of a central water system.

Improvements Next Five to Ten Years. By 1975 the population is expected to be five hundred. During this period it is proposed that a community water system facility be developed. Two wells with the combined capacity of four hundred gpm are proposed to supply the system. These wells should be located as shown on Map 9. A 150,000 gallon elevated storage tank is also proposed at this time. This will provide an adequate water system for the existing population, and it will be possible to expand the facility to supply the future population.

Improvements by 1990. By 1990 the population is expected to be fifteen hundred. Two additional wells with a combined capacity of four hundred gpm will be necessary during this period. A second storage facility with a capacity of 150,000 gallons is proposed and should be located as shown on Map 9. This will provide an adequate water system for the anticipated 1990 population. Minor repair and replacement and the expansion of the distribution system into new areas of development will be the only improvements necessary throughout the remainder of the planning period.

Gallatin Gateway

Existing System. The 210 persons who presently reside in this community use private wells for water supply. These wells are about forty feet in depth and produce adequate quantities of good quality water. There is sufficient population residing in this community to justify the construction of a central water system facility.

Improvements Next Five to Ten Years. For 1975 the population is expected to be two hundred. During this period it is proposed that a well with a capacity of 110 gpm be developed to supply a community water system. The system layout is shown on Map 10. A storage facility with a capacity of fifty thousand gallons is also proposed. This will provide an adequate water system for the needs of the community throughout the entire planning period.

Improvements by 1990. For 1990 the population is expected to be 175. A portion of this population decrease is believed to be due to the present lack of central sanitary facilities. The system as proposed under the five to ten year plan will provide a suitable water system for the needs of the community throughout the entire planning period. Only minor repair and replacement will be necessary to keep this system functioning satisfactorily.

Amsterdam and Churchill

Existing System. The combined population of these communities for 1970 is estimated to be three hundred. These communities are located sufficiently close to one another to be considered as one unit for water and sewer planning purposes. The residents of Churchill presently use private wells for water supply. These wells are about 130 to 220 feet deep and supply an adequate quantity of good quality water for each household. The community does have sufficient population density to warrant the construction of central water system facilities. The community of Amsterdam also relies on private wells for water supply. The wells in this community are from seventy to 150 feet deep and yield adequate quantities of good quality water for each household. This community also has sufficient population to justify the construction of a central facility. It would be possible to construct a community water system which would provide service to both communities, and it is feasible to do this.

Improvements Next Five to Ten Years. By 1975 the combined population of these communities is estimated to be 320. A community water system which would provide service to both communities is proposed for construction during this period. The system layout is shown on Map 11. A well with a capacity of 175 gpm would yield sufficient water for the needs. A storage facility with a capacity of 75,000 gallons is also proposed.

Improvements by 1990. For 1990 the combined population is expected to be 430. The system as proposed under the five to ten year plan will have sufficient capacity for this additional population. Minor repair and replacement will be required to keep the system in satisfactory operating condition.

Willow Creek

Existing System. The 175 persons who presently reside in this community rely on private wells for water supply. These wells are from thirty to fifty feet in depth and produce adequate quantities of good quality water. There is sufficient population presently residing here to make a community water system feasible.

Improvements Next Five to Ten Years. For 1975 the population is estimated to be 170. A community water system facility is feasible for this population, and it is proposed that it be constructed during this period. The system layout is shown on Map 12. A one hundred gpm well is proposed to supply the system. Storage facilities with a capacity of 35,000 gallons can be located on high ground to the east of the town.

Improvements by 1990. For 1990 the population is expected to be 150. A portion of this population decline can be attributed to the present lack of central sanitary facilities. The system as proposed under the five to ten year plan will be adequate for the needs throughout the entire planning period. Only minor repair and replacement will be necessary to keep the facility operating satisfactorily.

Logan

Existing System. The 125 persons who presently reside in this community obtain their water supply from private wells. These wells are from forty to fifty feet deep and furnish an adequate quantity of good quality water. There is sufficient population presently residing here to justify the construction of a central water system although local demand has not developed.

Improvements Next Five to Ten Years. By 1975 the population is expected to be 125, and a community water system facility is proposed for construction during this period. The system layout is shown on Map 13. A well with a capacity of seventy gpm will adequately supply the system. A constant pressure pumping facility is proposed in place of elevated storage. This system will provide adequate water service to the residents of the community throughout the entire planning period.

Improvements by 1990. By 1990 the population is expected to be one hundred. The system as proposed under the five to ten year plan will be adequate throughout the entire planning period. Only minor repair and replacement will be necessary for satisfactory operation.

Maudlow

Existing System. The present population is estimated to be twenty, and population projections indicate the community will decline throughout the planning period. The residents presently rely on private wells and springs for water supply. The wells range from sixty to 160 feet in depth and produce adequate quantities of good quality water. These private wells do provide a suitable water supply for the community.

Improvements by 1990. For 1990 the population is expected to be ten. The present use of private wells will continue to be the most suitable means of water supply for the residents of this community.

Central Park

Existing System. The twenty persons who presently reside in this community obtain their water supply from private wells. These wells range from forty to fifty feet in depth and produce adequate quantities of good quality water. These private systems do provide adequate water supplies for each household.

Improvements by 1990. The population is expected to increase throughout the planning period. By 1990 the population will have reached fifty. The present use of private wells will continue to be the most suitable means of water supply throughout the planning period. Ground water is abundant and new residents should have no problem in obtaining suitable wells.

COMMUNITY SEWER SYSTEM FACILITIES

General

Each use of water adds some material or alters some characteristic enough to change the original quality of the water and often to pollute it. The transportation and dilution of municipal, industrial, and agricultural wastes are important and necessary uses of water; therefore, special emphasis is placed on the control of water pollution from these sources. Some of these wastes can be carried in limited amounts without damage to the resource. Some wastes if discharged into water courses can make their way into underground aquifers and pollute the ground water so that it is unsuitable for further use.

Pollution by definition and interpretation is a matter of degree. Since it is inevitable that the quality of water will be altered with each use, it is of critical importance to control the degree of pollution.

It is public policy, established by the state legislature, to maintain reasonable standards of purity for the water of the state. These standards are to be consistent with the use of these waters, including their use in carrying away the water borne waste products of society. The current Federal Water Pollution Control Act in reference to pollution abatement gives the individual states discretion in assessing the physical and economic feasibility of complying with water quality standards. The "Water Quality Criteria," "Water Use Classifications," and "Policy Statements" of the Montana Water Pollution Control Council for streams and rivers in Montana have been included in Appendix I.

Sewage may be broadly categorized as domestic or municipal waste,

industrial waste, and animal or agricultural waste. Animal wastes are usually not involved in community sewage facilities; however, they do constitute a potential source of pollution which must be controlled and prevented from entering streams or other potential water supplies.

Although industrial activity throughout Montana has been limited, the need for control and treatment of industrial wastes is apparent. Industrial wastes vary in quantity and composition as greatly as the products and processes which generate them. They include toxic chemicals, solids carried in suspension, brines, strong acids and alkalies, oils, dyes, floating solids, and the heat generated by industrial processes. Industrial wastes are not found to be a major factor in the design of most community sewage facilities. Where economic projections indicate industrial development, the relationship to loading on domestic sewer systems is considered.

Domestic sewage is the primary consideration of this study and has been the basis for design and analysis. Where particular systems are subjected to loading from industrial sources, a more detailed study will be necessary. The general approaches outlined in "Analysis Criteria" in Appendix III will suffice in practically all cases.

Basic Considerations

There are generally three main methods of sewage disposal. These are septic tanks, mechanical sewage treatment plants, and wastewater stabilization ponds. Local soil conditions, availability of land, and density of population are the basic factors which govern the selection of a particular method.

Many of the smaller communities have relied on individual septic tanks and cesspools for each home to handle sewage disposal. Septic tanks are suitable if the population density is low and if the systems are properly designed and maintained. Overflow from these tanks must drain into the soil and, depending on local soil conditions, may or may not create a problem. There is a limit to the amount of water that even loose granular soil can absorb. Density of population and the length of time the effluent has been entering the soil are factors which indicate whether septic tanks can be suitable for sewage disposal.

When economically feasible, community sewage collection and disposal systems are much more desirable than individual systems. Community systems eliminate the worry of septic tank failure, and danger of well contamination, and the problem of soil saturation. However, it is usually uneconomical to serve a few homes scattered over a large area with a community sewer system.

The type of sewage disposal facilities to be used can generally be determined on the basis of economic factors. Mechanical treatment plants provide an excellent means of sewage disposal although the initial cost, maintenance cost, and power cost are usually high. Wastewater stabilization ponds are an ideal method of sewage disposal and usually are the most economical to construct and maintain.

The Montana Water Pollution Control Council has established the criteria that treatment of domestic and industrial wastes shall be secondary treatment or its equivalent. For domestic sewage, mechanical treatment plants or stabilization ponds, when either is properly designed, constructed, and operated, meet these requirements.

A schedule for completion of secondary treatment facilities by communities across the state has been established by the State Department of Health. The target date is included for individual towns when applicable.

Gallatin County

Approximately 17,850, or fifty six percent of the Gallatin County population, are presently served by community sewer facilities. By 1990 about 32,000, or sixty two percent of the population, will have access to community facilities if the proposed expansion program is followed. The remaining thirty eight percent will live in outlying areas, and the homes will not be close enough together to make community systems feasible.

Three Forks

Existing System. The present population is estimated to be 1,250. A community sewer system is in existence, and the system layout is shown on Map 16.

A collection system consisting of six, nine, ten, twelve, fifteen, eighteen, and twenty inch sewer mains picks up sewage from the entire town and carries it to a collection point near the northeast end of town. This collection system has sufficient capacity throughout most areas of the town; however, there is a serious infiltration problem, and as a result excessive flows occur in the system. A twenty inch outfall line continues on from the collection point to a lift station. This lift station then forces sewage on through a twelve inch force main to the wastewater stabilization pond. Because of the high flows caused by the infiltration water, the lift station does not have sufficient pumping capacity for all of the sewage. For this reason, most sewage is allowed to flow directly into the river completely bypassing

the treatment facilities. Sewage treatment presently consists of an 18.3 acre wastewater stabilization pond. This facility would have adequate capacity for the present and future population if excessive infiltration water did not exist.

Improvements Next Five to Ten Years. By 1975 the population is expected to be thirteen hundred. The existing sewer system facility would have adequate capacity for domestic sewage from this population. The existing lines are old and badly deteriorated. As a result, there is the high infiltration previously mentioned. This collection system is in such poor condition that continual cleaning and flushing must be done. To completely stop the infiltration water and to eliminate the maintenance problems caused by the older lines, complete replacement of the existing collection system would be necessary. During this period it is proposed that the community begin replacing the areas of the collection system which are causing the major problems. A study should be conducted to determine the most serious problems and efforts to correct these operational problems should be concentrated in these areas. Expansion of the collection system into new areas of development will also be necessary during this period. The lift station, force main, and treatment facilities have adequate capacity for this expansion providing the present infiltration problem can be reduced.

Improvements by 1990. For 1990 the population is expected to be fifteen hundred. Improvements to the collection system will continue to be necessary during this period, but it is expected that infiltration will be reduced to a minimum during this period. Expansion of the collection system into new areas of development will continue to be necessary throughout the planning period.

Belgrade

Existing System. The 1970 population is estimated to be one thousand. The residents are served by a partial sewer system; however, most homes rely on private septic tanks. The soil is primarily a gravel material so that major operational problems do not exist. There is sufficient population residing here to require a complete sewer system facility. Present population density is sufficient to make the improvement necessary, and the population is expected to increase substantially throughout the planning period.

Improvements Next Five to Ten Years. For 1975 the population is expected to be eleven hundred. During this time it is proposed that a complete sewer system be developed in the community. A layout of the proposed system is shown on Map 17. The existing collection system consisting of six, eight, and twelve inch sewer mains carries sewage to a collection point near the northwest edge of town. From this

point a twelve inch outfall line continues on to the treatment facilities which consist of a 3.25 acre wastewater stabilization pond. This outfall line and a portion of the collection system can be used for the starting point in establishing complete sewer system facilities. The twelve inch outfall line will have sufficient capacity for the anticipated 1990 population. A twelve acre addition to the wastewater stabilization pond will be necessary during this period. This will result in a 15.25 acre surface area which is adequate for the anticipated 1990 population. The new collection system should consist of eight inch diameter sewer main as shown on Map 17. The area southeast of the railroad tracks may possibly require a lift station in order that service can be provided.

Improvements by 1990. By 1990 the population is expected to be fifteen hundred. The system as proposed under the five to ten year plan will have sufficient capacity for the needs of this population. Expansion of the collection system into new areas of development will continue to be necessary. The proposed system has sufficient capacity for this expansion. Minor repair and replacement will be necessary throughout the entire planning period.

Manhattan

Existing System. The estimated 1970 population is nine hundred. A community sewer system is in existence, and the system layout is shown on Map 18.

A collection system consisting of eight, ten, and twelve inch sewer mains picks up sewage from throughout the community and carries it to the north edge of town. This collection system has adequate capacity for the present sewage flow except where the older lines allow infiltration water to enter the system. Some of the older lines, which exist in the southeast edge of town, allow excessive amounts of infiltration water to enter the system and should be replaced. From the collection point a twenty inch outfall line continues on to the treatment facility. This outfall line has sufficient capacity for the sewage flows from the present and future populations of the town. Treatment facilities presently consist of an 11.2 acre wastewater stabilization pond. This facility has sufficient capacity to serve the present and future populations of the community. The existing collection system makes service available to practically all homes located in the town limits. There are some residences at the outlying edges of town that do not have sewer service at the present time. It is feasible to expand the collection system to provide service to them.

Improvements Next Five to Ten Years. The population is expected to increase steadily throughout the planning period, and by 1975 the

population will be 910. During this period it is proposed that the collection system be improved to eliminate infiltration water. The areas of the system where infiltration is occurring can be determined and a replacement program undertaken to eliminate the sources of trouble. Also, it is proposed that the existing collection system be extended to provide service to all homes which exist in the community. The existing system has sufficient capacity for this additional loading.

Improvements by 1990. For 1990 the population is expected to be 950. The existing system together with the improvements proposed under the five to ten year plan will result in a facility which is adequate for the needs throughout the entire planning period. Minor repair and replacement will be necessary to keep this system in satisfactory operating condition. Expansion of the collection system into new areas of development will be necessary during this period. The existing facility has sufficient capacity for this expansion.

West Yellowstone

Existing System. The permanent population of West Yellowstone is estimated to be five hundred. Substantial population increase is projected throughout the planning period. A community sewer system facility is in existence, and the layout is shown on Map 19.

A collection system consisting of eight and ten inch sewer mains picks up sewage from the entire community and carries it to a collection point near the west edge of town. This collection system has sufficient capacity for the present and future anticipated sewage flows. From the collection point a lift station forces sewage through a ten inch force main to the treatment facilities. This lift station and force main are of adequate size to serve the anticipated future population. There is a substantial increase in population during the summer months because of tourism in the area. The combined effect of the permanent and transient population is not definitely known; however, the existing sewer system does reportedly function satisfactorily. Sewage treatment is provided by an aerated wastewater stabilization pond. This treatment facility has a capacity of 450,000 gallons per day which is equivalent to a population of 4,500. This treatment facility does provide adequate sewage treatment.

Improvements Next Five to Ten Years. By 1975 permanent population is expected to be 550. No major improvements to the sewer system are believed to be necessary during this period. Expansion of the collection system into new areas of development will be necessary, and the existing facility has sufficient capacity for this expansion. Minor repair and replacement will be necessary to keep the system in

satisfactory operating condition.

Improvements by 1990. For 1990 the estimated permanent population is 750. The additional summer population because of tourist traffic is expected to continue at about the present level. The existing sewer system facility will have adequate capacity for the needs of the 1990 population. Expansion of the collection system into new areas of development will continue to be necessary, and the existing system has sufficient capacity for this. Repair and replacement will continue to be necessary throughout the entire planning period.

Bozeman Hot Springs

Existing System. The 350 persons who presently reside in the area of Bozeman Hot Springs rely on private septic tanks for sewage disposal. The soil in the area is primarily a gravel material so that major operational problems do not exist. Relatively shallow water wells do exist in the area, and the possibility of septic tank overflows reaching these wells is apparent. A community sewer system is feasible for the present population.

Improvements Next Five to Ten Years. The population is expected to increase substantially throughout the planning period and by 1975 will have reached five hundred. A community sewer system could be developed in the more densely settled areas. The natural slope of the land is to the north so that the treatment facilities should be located north of State Highway 289. The collection system should then extend to the more densely settled areas with the objective that it can be extended to new areas of development as they occur. It is anticipated that the area can be served entirely by a gravity system if such a system is properly developed. A layout of the proposed system is shown on Map 20.

Improvements by 1990. For 1990 the population is expected to be fifteen hundred. It is expected that this population will be spread over a rather large area, and some of the development may occur in such a manner that there is not sufficient density of population to warrant building a community sewer system. The system as proposed under the five to ten year plan will either have sufficient capacity as proposed or it will have the necessary flexibility for expansion to serve new areas.

Gallatin Gateway

Existing System. The 210 persons who presently reside in this community rely on private septic tanks for sewage disposal. The soil

in the area varies from sandy to heavy clay and many operational problems are experienced. There is a high water table in the spring which causes drainfields to function unsatisfactorily. There is considerable maintenance involved since pumping is necessary about every two years. A community sewer system is feasible for this population, and a layout of the proposed system is shown on Map 21.

Improvements Next Five to Ten Years. For 1975 the population is expected to be two hundred. A community sewer system is feasible to serve this population. A collection system consisting of eight inch sewer main could pick up sewage from throughout the community and carry it to a collection point near the north end of the town. At this point a lift station would be necessary to force the sewage on to the treatment facilities. A four inch force main would have adequate capacity throughout the planning period. Sewage treatment could be provided by a two acre wastewater stabilization pond.

Improvements by 1990. By 1990 the population is expected to decline to 175. A portion of this decrease can be attributed to the present lack of adequate sanitary facilities. The system as proposed under the five to ten year plan is also feasible for this reduced population. Minor repair and replacement are the only improvements which will be necessary for the proposed system throughout the remainder of the planning period.

Amsterdam and Churchill

Existing System. The combined 1970 population of these communities is three hundred. The towns are located close enough together to be considered as one unit for planning purposes. Both communities presently rely on private septic tanks and cesspools for sewage disposal. The soil varies from sandy to clayey, and many operational problems presently exist. In some areas the sewage does not drain away properly and appears on the surface of the ground. There is also evidence of stream pollution because of septic tank overflows. A community sewer system is feasible for this community, and a layout of the proposed system is shown on Map 22.

Improvements Next Five to Ten Years. By 1975 the combined population of these communities is expected to be 320. Population projections indicate that the communities will continue to grow through 1990. The community sewer system is proposed for construction during this period. Sewage from both communities can be collected at a point near the north edge of town. A lift station will be necessary to pump the sewage from Amsterdam on to the wastewater stabilization pond. Sewage from the community of Churchill can be taken directly to the treatment facility by gravity except for the low area near the south edge of the

community. Sewage disposal can be handled by a 4.3 acre wastewater stabilization pond.

Improvements by 1990. For 1990 the estimated population is 430. The system as proposed under the five to ten year plan will have sufficient capacity for this population. Expansion of the collection system into new areas of development may be necessary. The proposed system has sufficient capacity for this expansion.

Willow Creek

Existing System. The 175 persons who presently reside in this community rely on private septic tanks for sewage disposal. The soil in the area is primarily sandy so that major operational problems do not exist with properly developed systems. Some residents have not constructed proper drainfields and allow septic tank overflows to drain into open fields. This is an undesirable situation and one which can be alleviated.

Improvements Next Five to Ten Years. By 1975 the population is expected to be 170. During this period it is proposed that a community sewer system be developed. The community can be drained entirely by gravity, and a system of eight inch sewer main is proposed for the collection system. Sewage disposal can be handled by a two acre wastewater stabilization pond. This improvement has been actively pursued by the residents of the community. The last attempt to construct a community sewer system did not receive the full support of the residents. It is expected that the improvement will receive the approval of the majority the next time it is proposed.

Improvements by 1990. For 1990 the population is expected to decline to 150. A portion of this decrease can be attributed to the present lack of suitable sanitary facilities. The system as proposed under the five to ten year plan will have sufficient capacity for the needs of the 1990 population.

Logan

Existing System. The 125 persons who presently reside in this community rely on private septic tanks for sewage disposal. These systems reportedly function satisfactorily because the soil in the area is primarily sand with good drainage properties. It is feasible to construct a community sewer system for the present population. Population projections indicate that the community will remain essentially steady throughout the planning period.

Improvements Next Five to Ten Years. For 1975 the population is expected to be 125. A community sewer system is proposed during this period, and a layout of this system is shown on Map 24. The area of the town located on each side of the tracks can be drained westerly by a system of eight inch sewer mains. A lift station will be necessary to force the sewage on to the treatment facilities. A four inch force main will have sufficient capacity to do this. The treatment facility could consist of a 1.5 acre wastewater stabilization pond.

Improvements by 1990. For 1990 the population is expected to be one hundred. The system as proposed under the five to ten year plan will have sufficient capacity for the needs of the community throughout the entire planning period. Only minor repair and replacement will be necessary to keep the system in satisfactory operating condition.

Maudlow

Existing System. The twenty persons who presently reside in this community rely on private septic tanks for sewage disposal. These systems do not present major operational problems since the soil in the area is primarily sand with good drainage properties. These private systems do provide suitable sewage disposal for this community.

Improvements by 1990. By 1990 the population is expected to decline to ten. Throughout the entire planning period the present use of private septic tanks will provide suitable sewage disposal for this community.

Central Park

Existing System. The twenty persons who presently reside in this community rely on private septic tanks for sewage disposal. These systems reportedly function satisfactorily since the soil in the area is gravelly and has good drainage properties. The use of private septic tanks does provide a suitable method for sewage disposal.

Improvements by 1990. The population is expected to increase to fifty by 1990. The present use of private septic tanks will continue to be the most suitable and the most feasible means of handling sewage disposal for this community throughout the entire planning period.

PREFACE TO MAPS

The following maps have been prepared from several sources. The county maps were prepared from Transverse Mercator Projection Series Maps and Montana Highway Department Maps, Planning and Survey Series. The reduction of the county maps necessary for this publication makes them useful for general reference purposes only.

The town and community base maps used herein are taken from Montana State Highway Commission City and Town Plats prepared from aerial photographs dated 1961 to 1969 and have been updated where necessary. On-site surveys, plats obtained from individual towns, and aerial photography conducted in 1970 were also used. Uncontrolled mosaics have been used and scales are, accordingly, only approximate and are shown for referencing purposes only. The mapping operation was supplemented by field checks made during 1970.

Land use information was obtained by field surveys, supplemented and checked by aerial photography during 1969 and 1970.

Water and sewer systems maps show existing facilities for individual towns and communities except where the information was not available. Data concerning these community facilities was obtained from the records of the individual communities and of the State Department of Health. Water and sewer lines are shown in the center of streets to indicate the existence of lines rather than precise locations. The sizes of lines, obtained from the most current information available, are indicated when possible. The locations of recommended improvements are given as relative locations and are not meant to be scaled from the individual town or community maps.

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MAP I

COUNTY MAP
GENERAL RELIEF

LEGEND

● CITIES-TOWNS

○ COUNTY SEAT

ROADS-HIGHWAYS

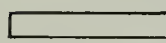
———— STATE HIGHWAY U. S. HIGHWAY

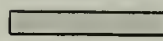
----- RAILROADS

 STREAMS-LAKES

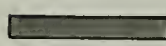
— COUNTY BOUNDARY

..... INDIAN RESERVATION

 0-3,000 FT. ELEVATION

 3-5,000 FT. ELEVATION

 5-7,000 FT. ELEVATION

 OVER 7,000 FT. ELEVATION

MAP 2

LEGEND

MAJOR STATE-WIDE COVERAGE

POWER AND GAS SYSTEMS

-  POWER PLANT (IN MEGAWATTS)
-  1 to 50 KILOVOLTS
-  51 to 100 KILOVOLTS
-  101+ KILOVOLTS
-  PROPOSED LINES
-  GAS LINES

RECREATION AREAS

1. LOST CREEK STATE PARK
 2. LEWIS AND CLARK CAVERNS STATE PARK
 3. LAKE MARY RONAN STATE PARK
 4. MEDICINE ROCKS STATE PARK
 5. ROSEBUD STATE PARK
 6. ROCK CREEK STATE PARK
 7. MAKOSHIKA STATE PARK
 8. WEST SHORE STATE PARK
 9. WOODS BAY STATE PARK
 10. BITTERROOT LAKE STATE PARK
 11. ASHLEY LAKE STATE PARK
 12. LONE PINE STATE PARK
 13. JAMES KIPP STATE PARK
 14. HOOPER MEMORIAL STATE PARK
 15. HELL CREEK STATE PARK
 16. FINLEY POINT STATE PARK
 17. ELMO STATE PARK
 18. FLATHEAD LAKE STATE PARK
 19. YELLOW BAY STATE PARK
 20. WALSTAD MEMORIAL PARK
 21. THOMPSON FALLS STATE PARK
 22. WHITEFISH LAKE STATE PARK
 23. WAYFARERS RECREATION AREA
 24. TIBER RESERVOIR RECREATION AREA
 25. CLARK CANYON RESERVOIR RECREATION AREA
 26. ENNIS RECREATION AREA
 27. DEADMAN'S BASIN RESERVOIR RECREATION AREA
 28. PAINTED ROCKS RESERVOIR RECREATION AREA
 29. CANYON FERRY RECREATION AREA
 30. LOGAN PARK RECREATION AREA
 31. NELSON RESERVOIR RECREATION AREA
 32. BEAVERTAIL HILL RECREATION AREA
 33. GLACIER NATIONAL PARK
 34. YELLOWSTONE NATIONAL PARK
-  NATIONAL FORESTS

MAP 3

COUNTY MAP LAND OWNERSHIP

LEGEND

● CITIES-TOWNS

○ COUNTY SEAT

ROADS-HIGHWAYS

———— STATE HIGHWAY U. S. HIGHWAY

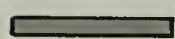
----- RAILROADS

 STREAMS-LAKES

..... COUNTY BOUNDARY

 INDIAN RESERVATION

 PRIVATELY OWNED LAND

 STATE OWNED LAND

 FEDERAL OWNED LAND

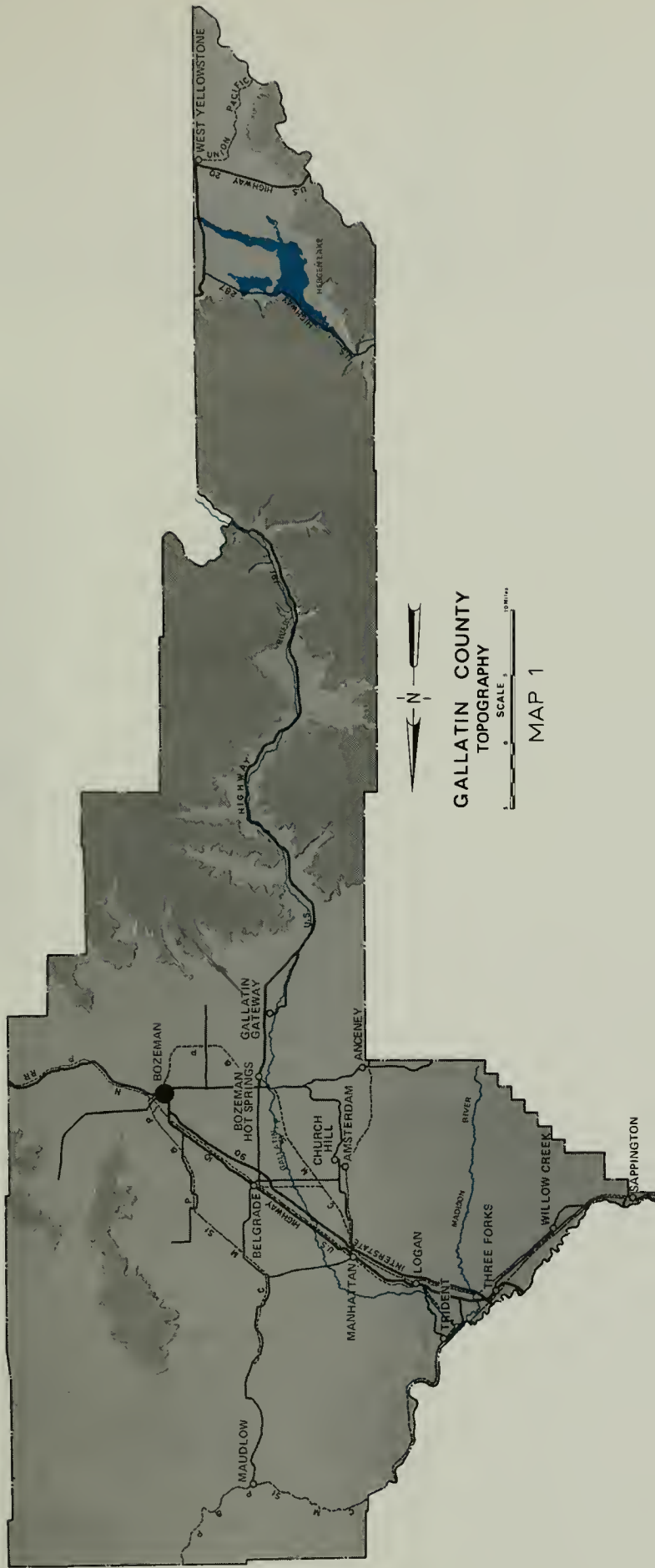
CITIES MAP LEGEND

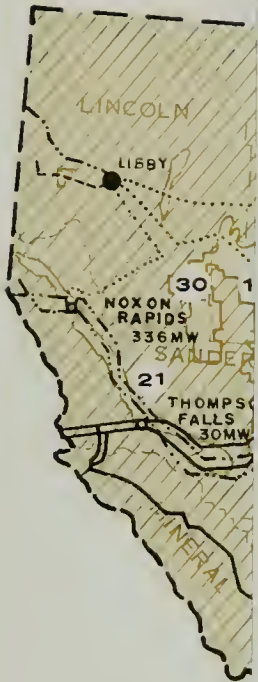
LAND USE

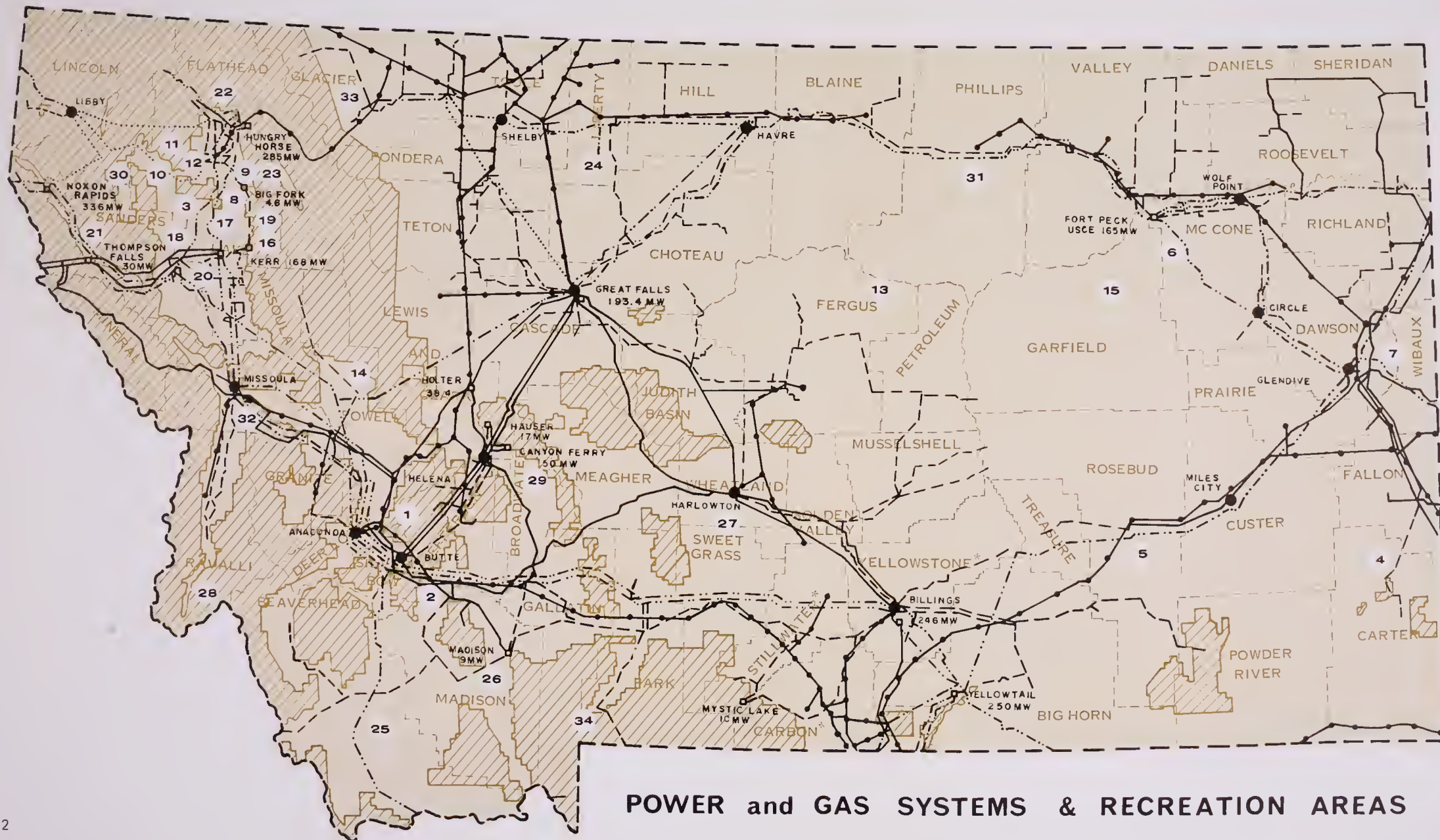
-  SINGLE RESIDENCE
-  DILAPIDATED RESIDENCE
-  SINGLE TRAILER RESIDENCE
-  MULTIPLE RESIDENCE
-  APARTMENTS
-  TRAILER COURT
-  COMMERCIAL BUILDING
-  HOTEL-MOTEL
-  PUBLIC BUILDING
-  SCHOOL
-  CHURCH
-  HOSPITAL
-  INDUSTRIAL
-  GRAIN ELEVATOR

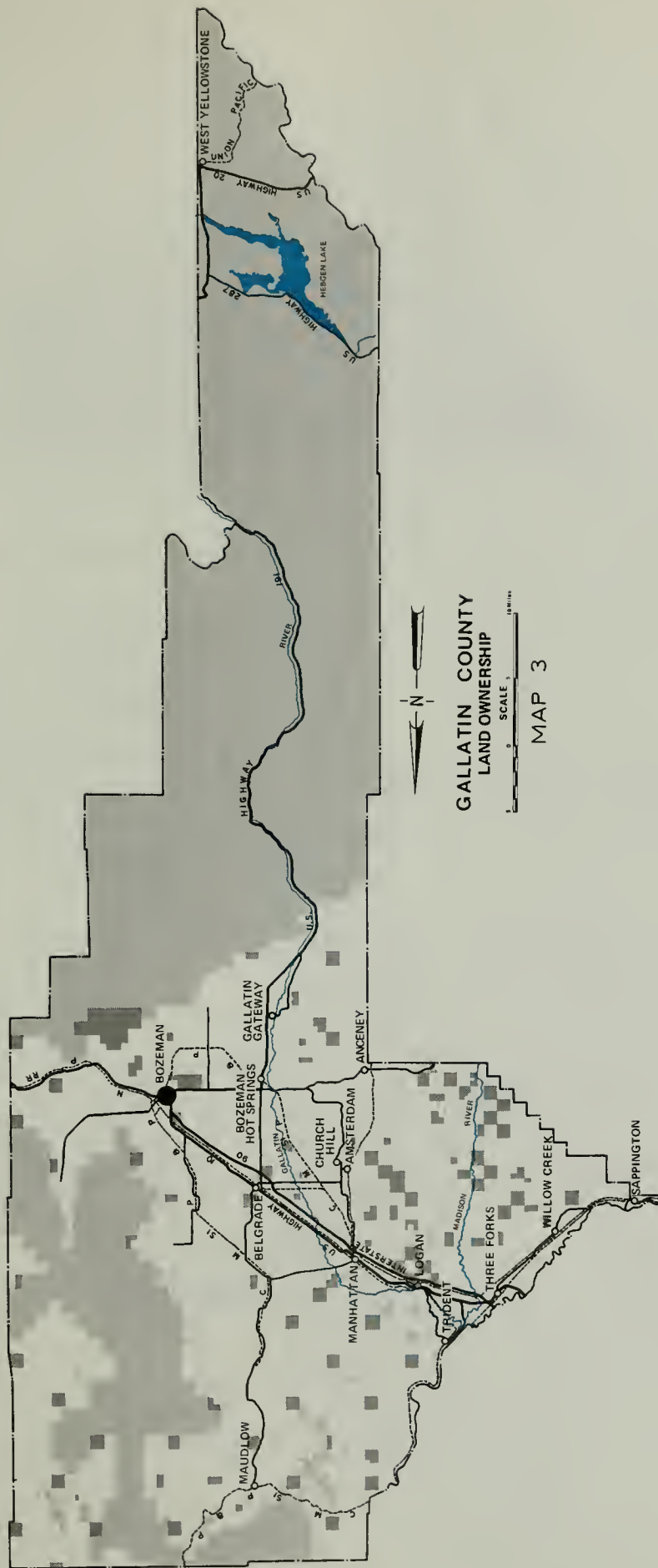
WATER and SEWER SYSTEMS

-  EXISTING LINES AND SIZES
-  PROPOSED LINES 5-10 YEAR
-  PROPOSED LINES 10-20 YEAR
-  EXISTING LIFT STATION
-  PROPOSED LIFT STATION
-  EXISTING WATER STORAGE TANK
-  PROPOSED WATER STORAGE TANK
-  EXISTING WATER SOURCE
-  PROPOSED WATER SOURCE
-  EXISTING TREATMENT FACILITIES
-  PROPOSED TREATMENT FACILITIES
-  SERVICE AREA 1970-1980
-  SERVICE AREA BY 1990

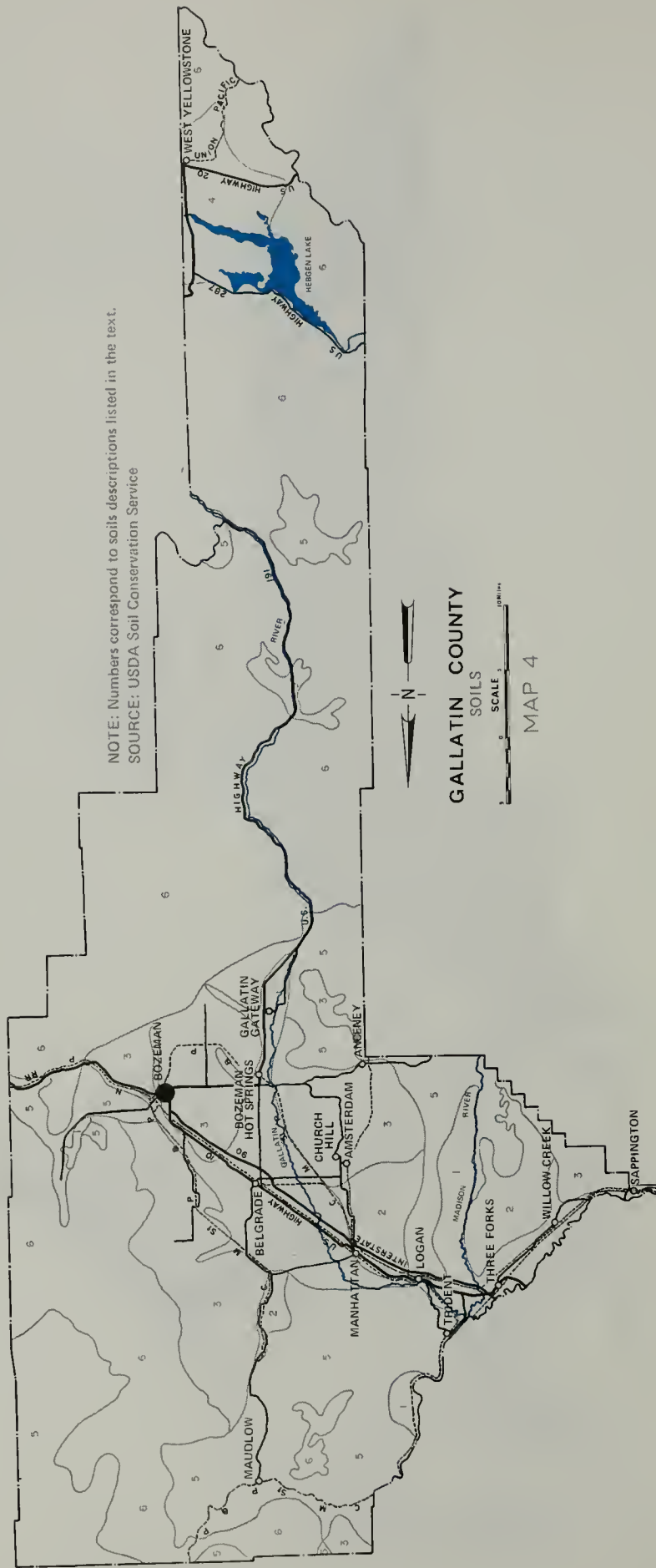






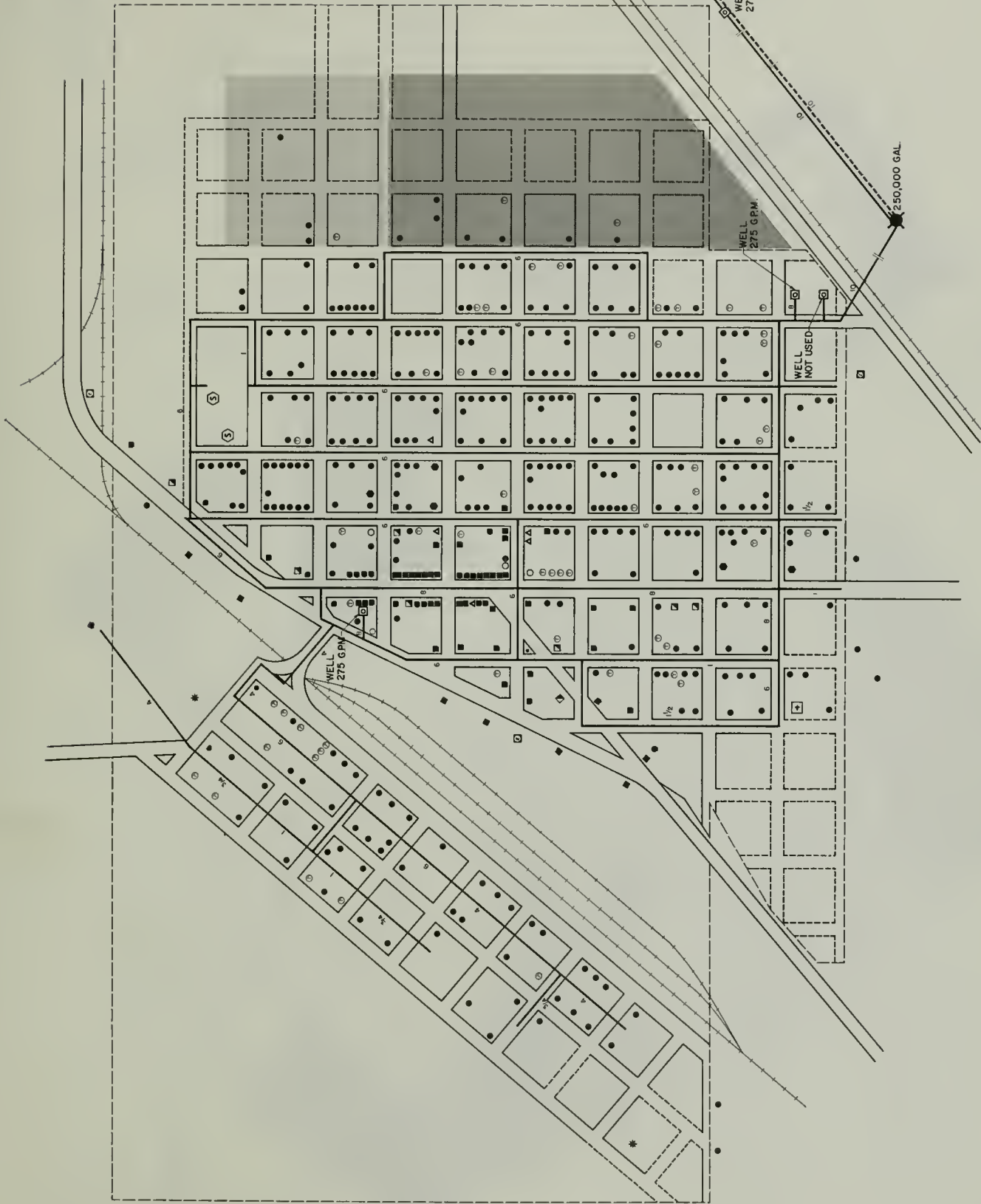
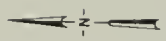


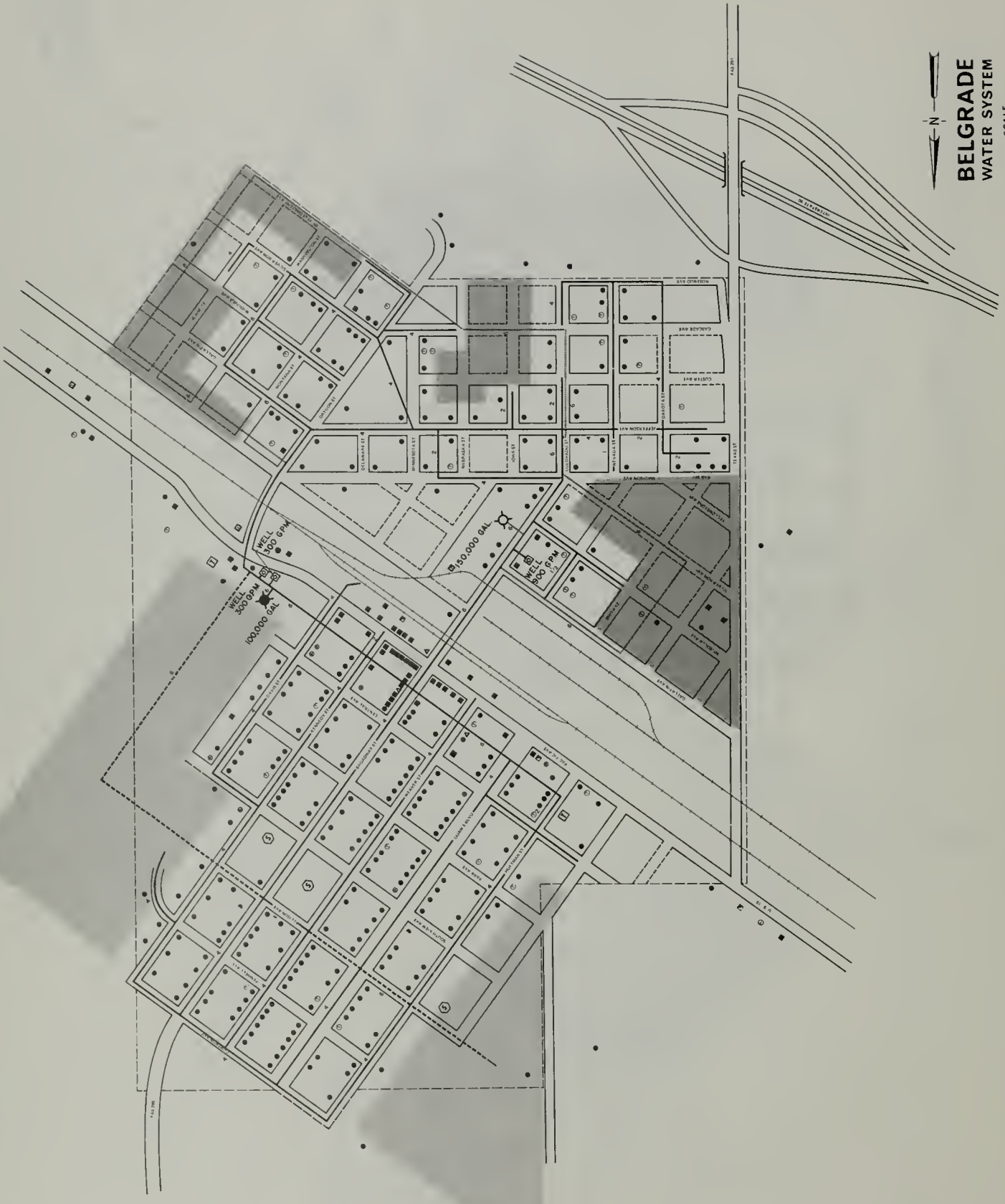




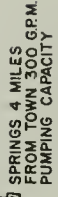
NOTE: Numbers correspond to soils descriptions listed in the text.
 SOURCE: USDA Soil Conservation Service

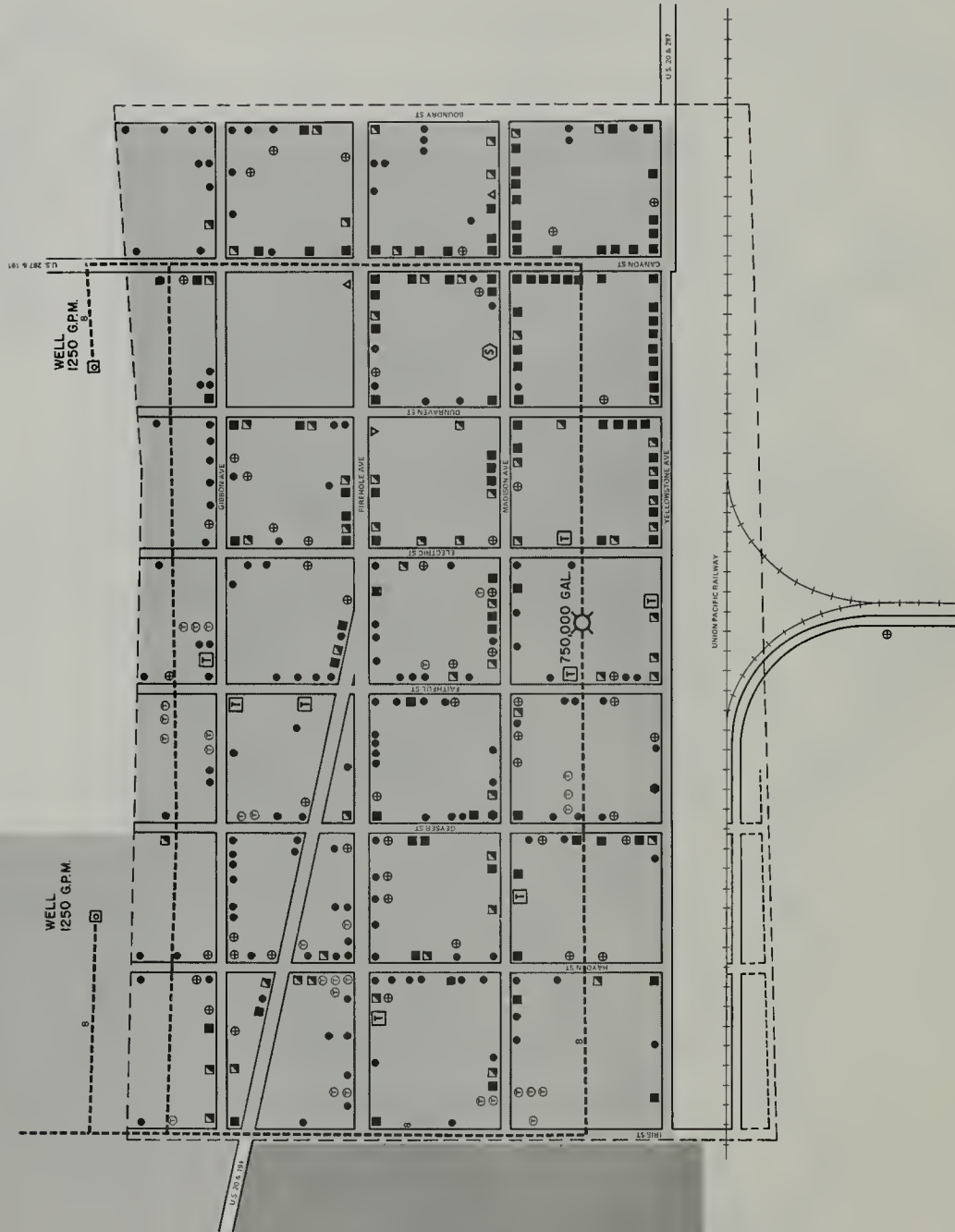
GALLATIN COUNTY
 SOILS
 SCALE 0 5 10 MILES
 MAP 4





MAP 7





WEST YELLOWSTONE WATER SYSTEM

SCALE
1" = 100'
1" = 200'
1" = 400'

MAP 8

WELL
200 G.P.M.

WELL
200 G.P.M.

WELL
200 G.P.M.

WELL
200 G.P.M.

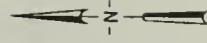
150,000 GAL.

150,000 GAL.

FAS 289

U.S. 191

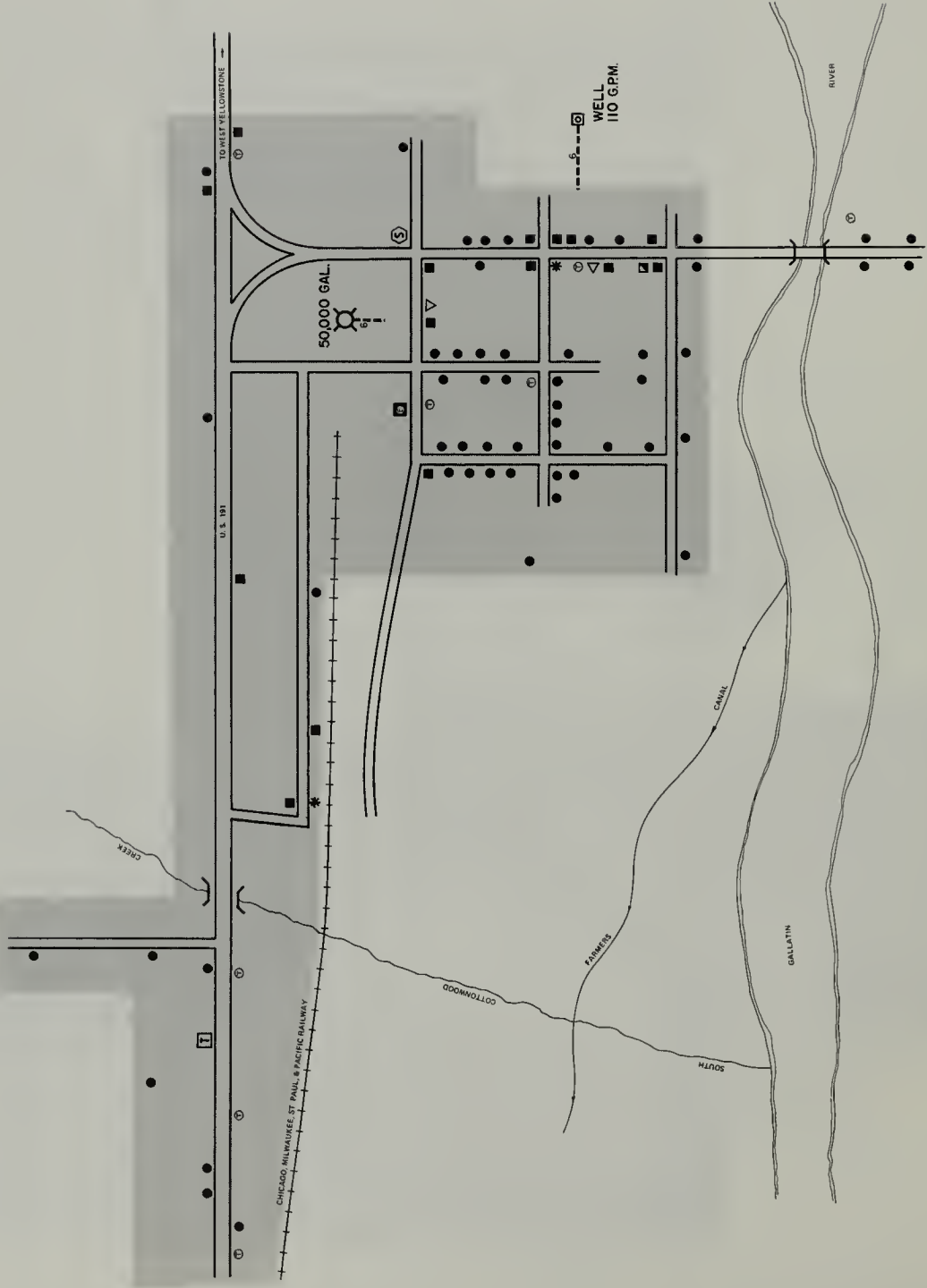
U.S. 191



SCALE
0 100 200 400

MAP 9

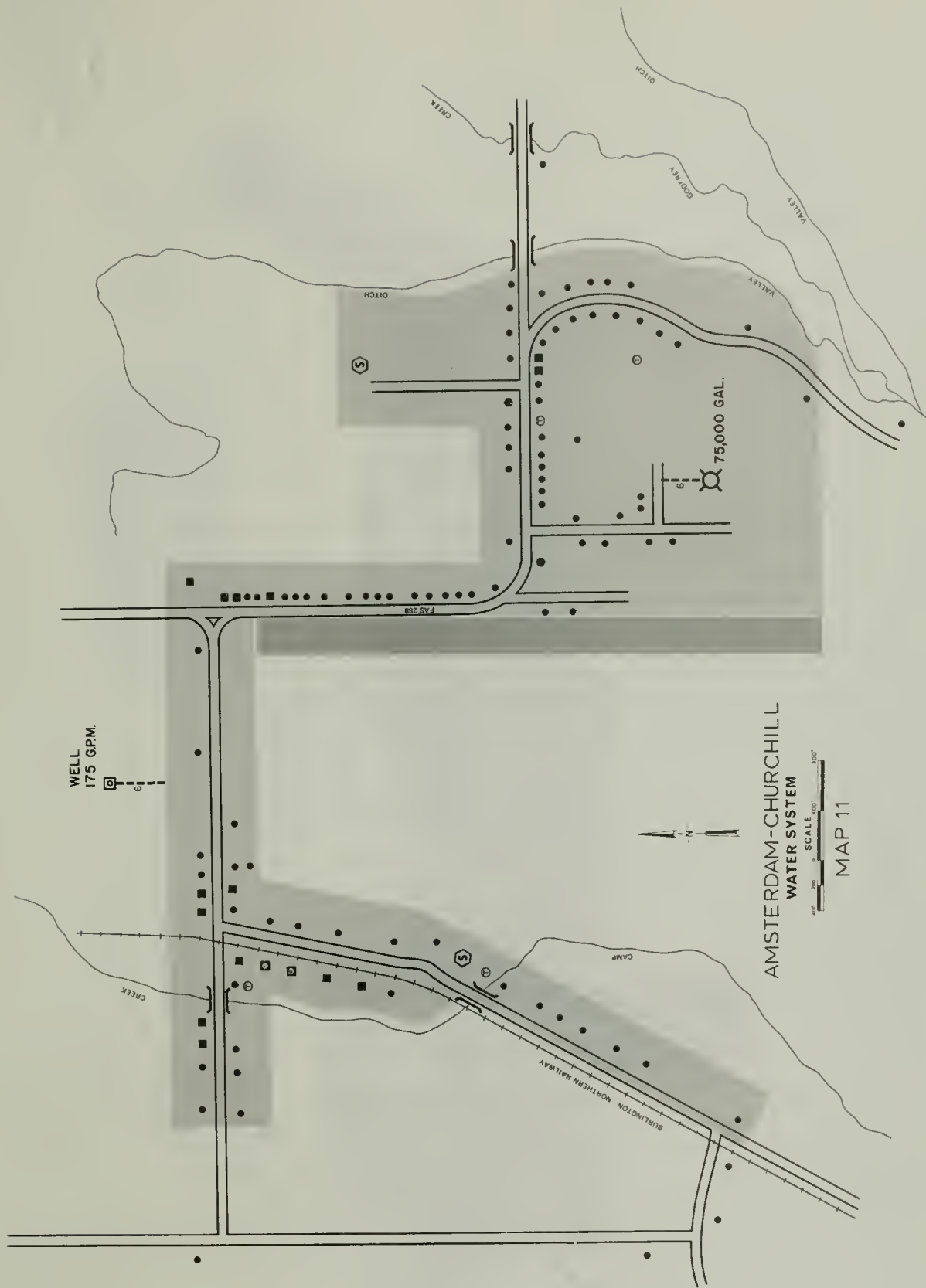
BOZEMAN HOT SPRINGS WATER SYSTEM

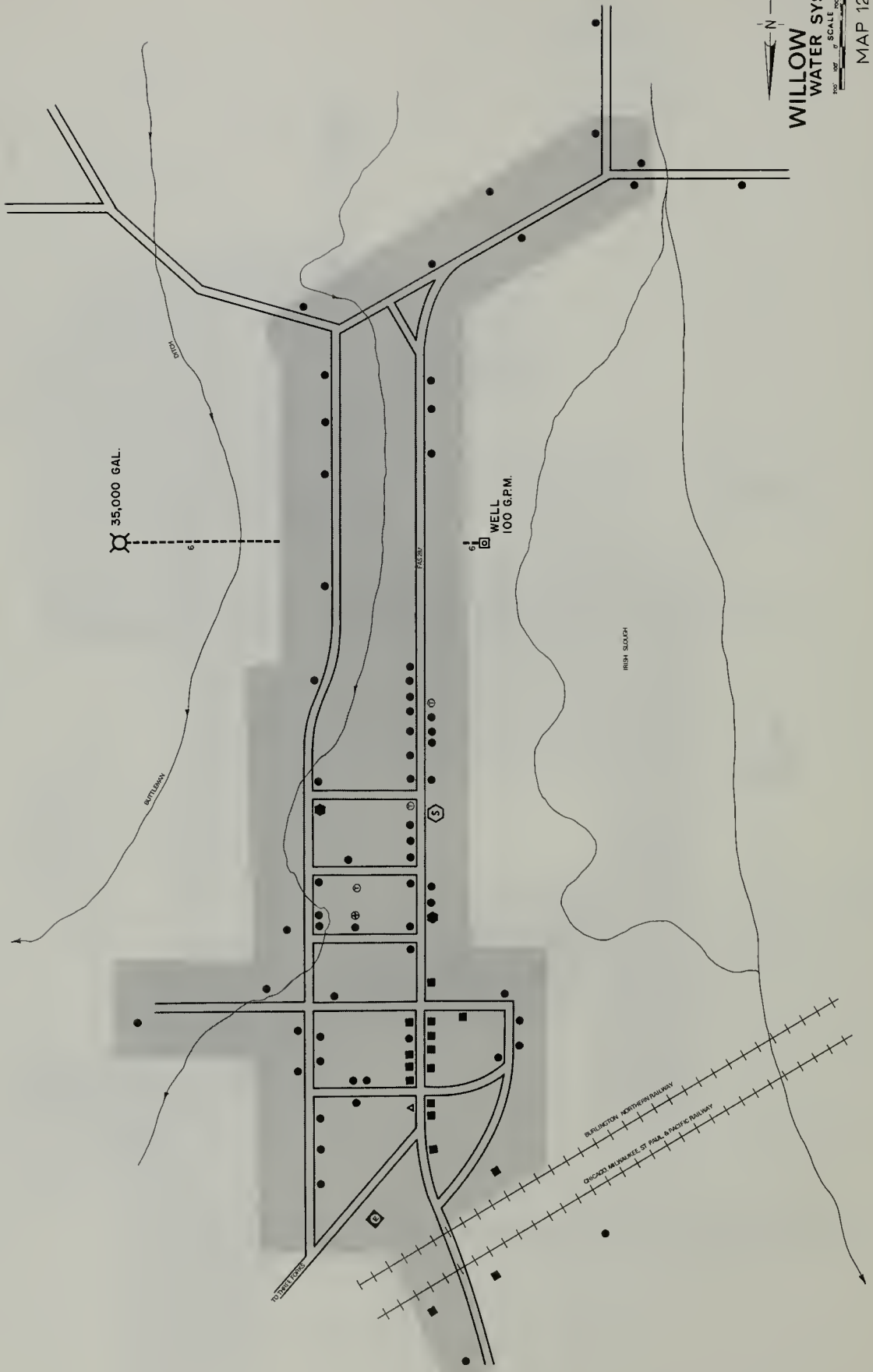


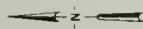
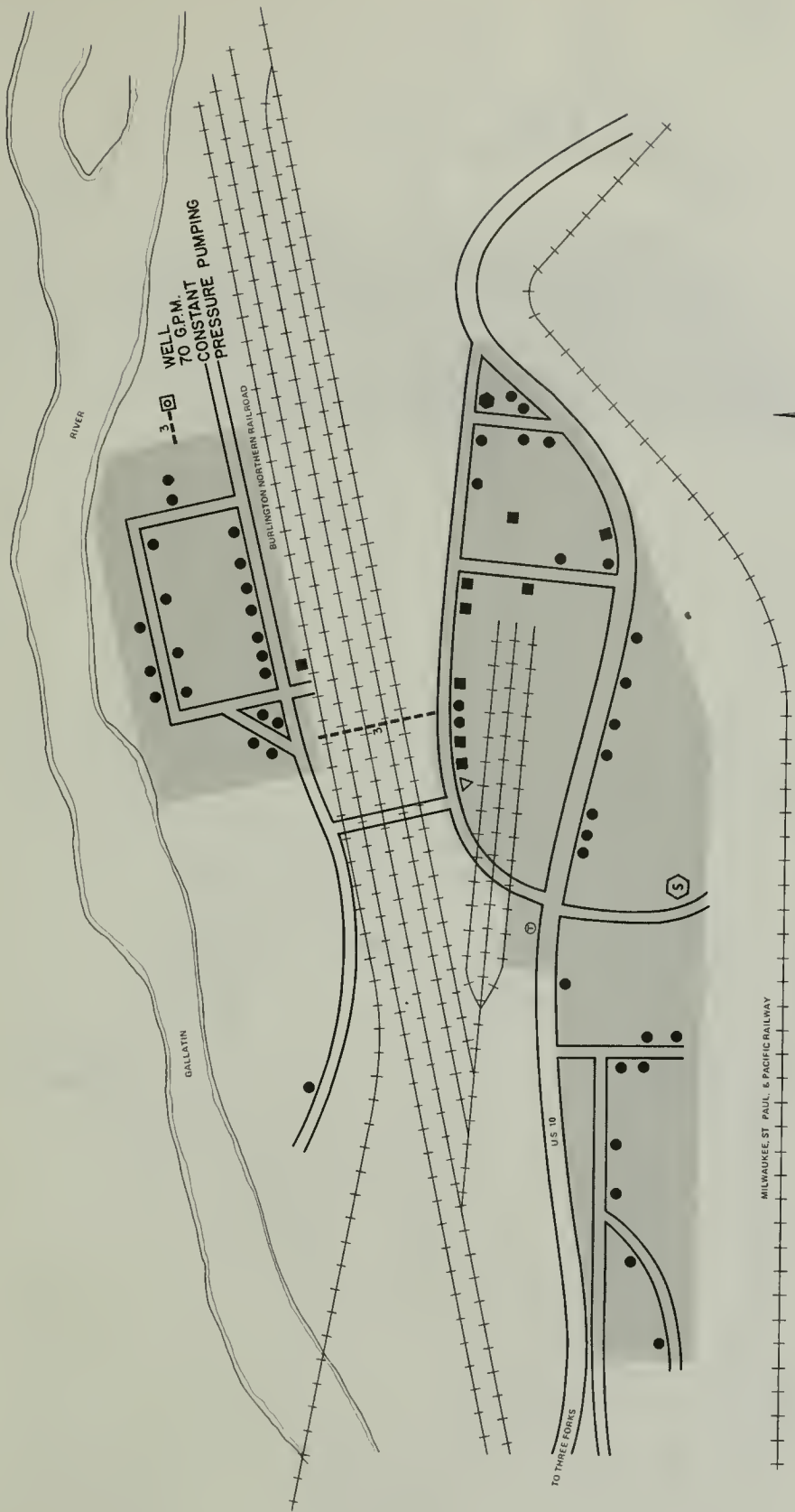
GALLATIN GATEWAY WATER SYSTEM

SCALE
1" = 100'

MAP 10

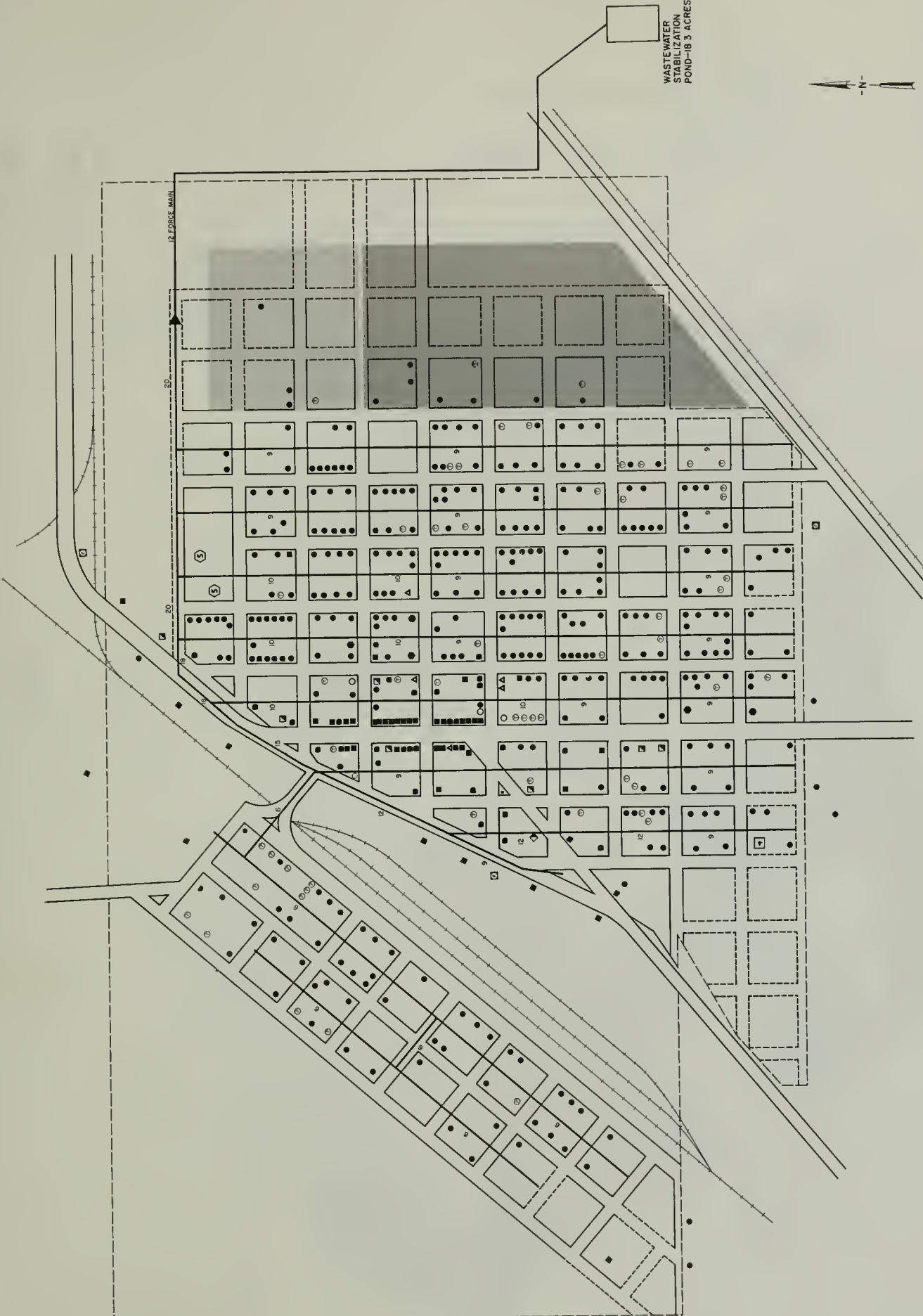




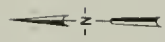


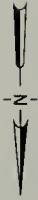
LOGAN
WATER SYSTEM
SCALE 1" = 100'
MAP 13

TO THREE FORKS
INTERSTATE 90



WASTEWATER
STABILIZATION
POND—18.3 ACRES

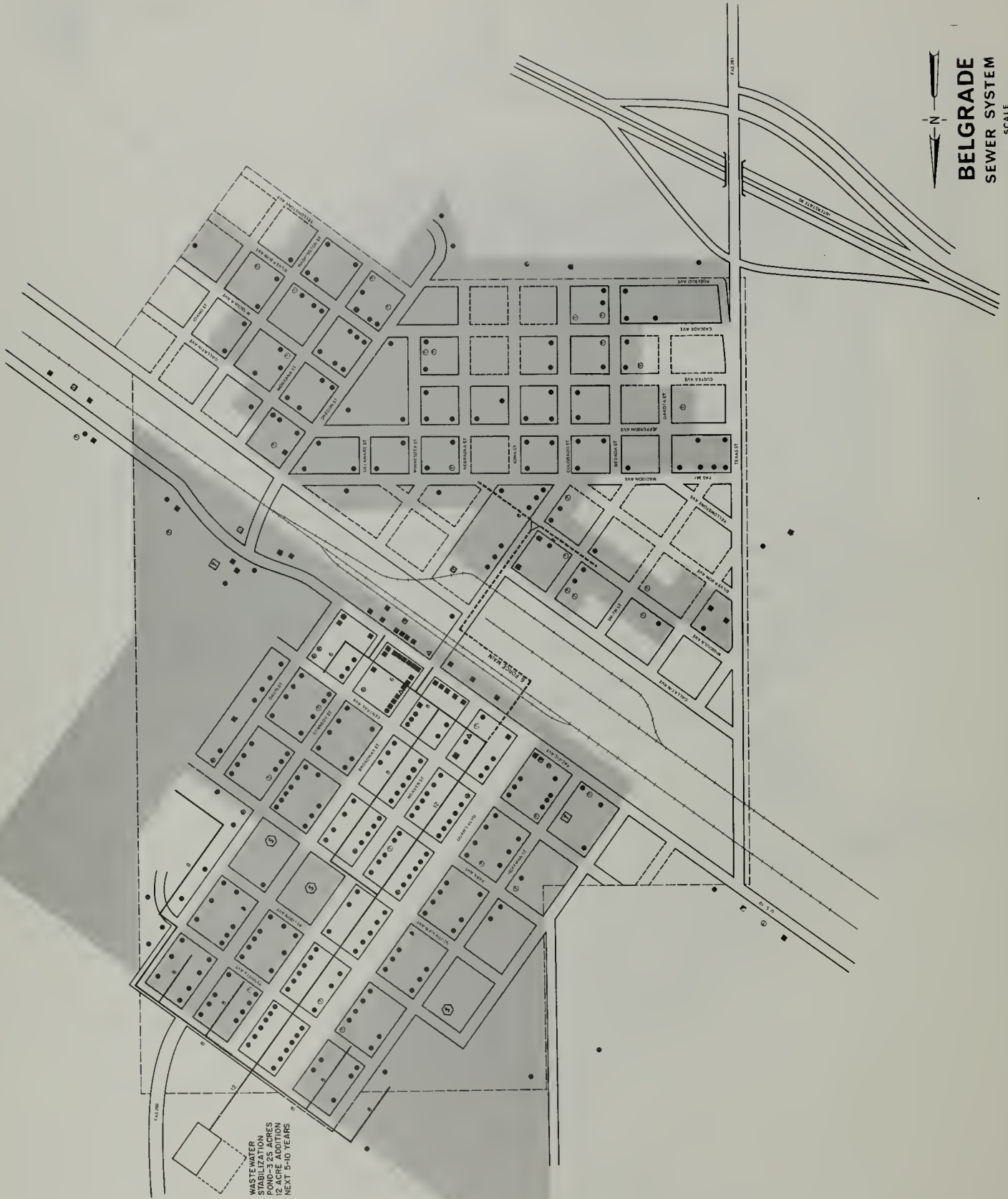




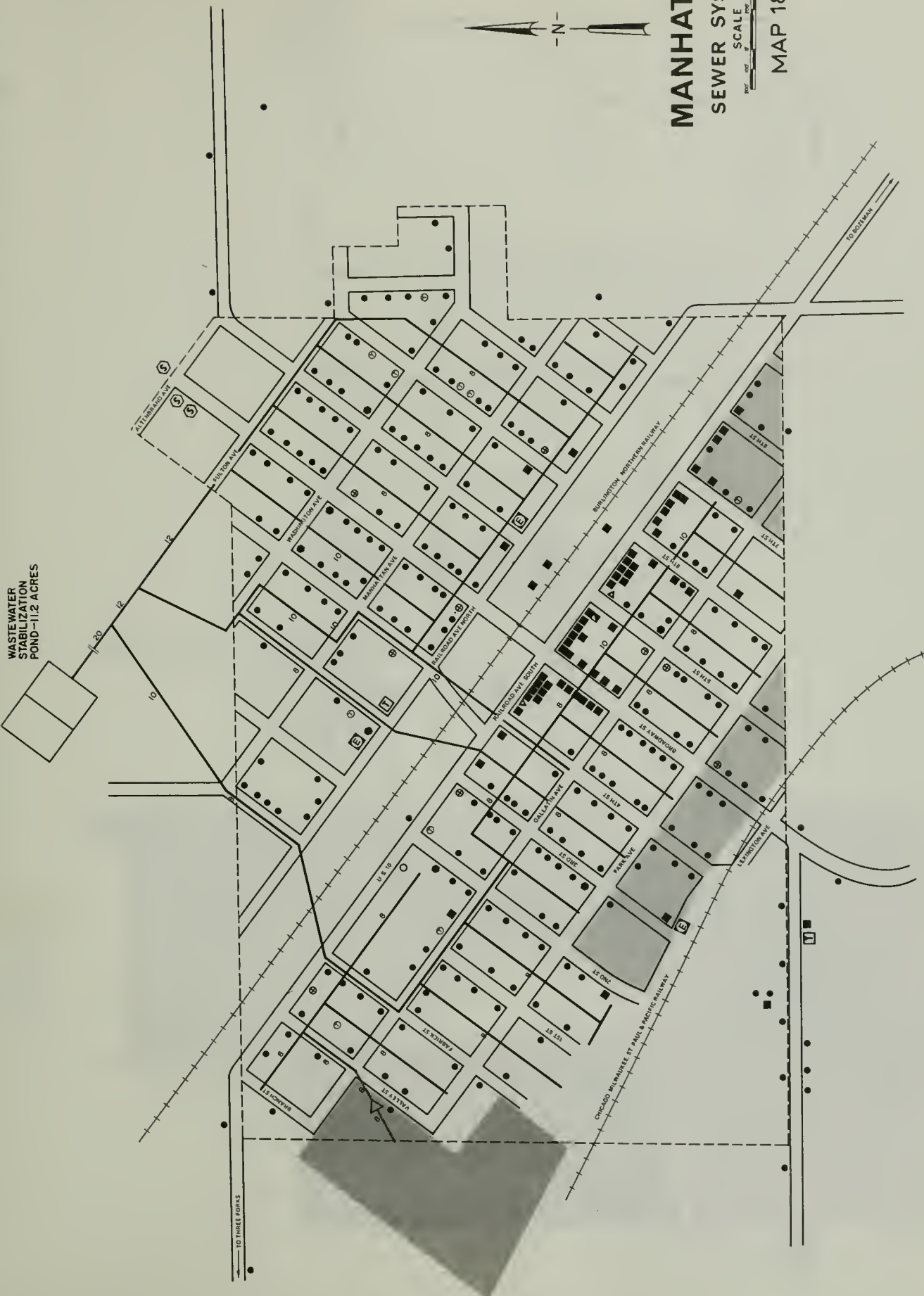
**BELGRADE
SEWER SYSTEM**

SCALE
1" = 200'

MAP 17



WASTEWATER
STABILIZATION
POND—11.2 ACRES



MANHATTAN

SEWER SYSTEM

SCALE 1" = 100'

MAP 18



SCALE

MAP 19

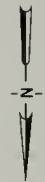
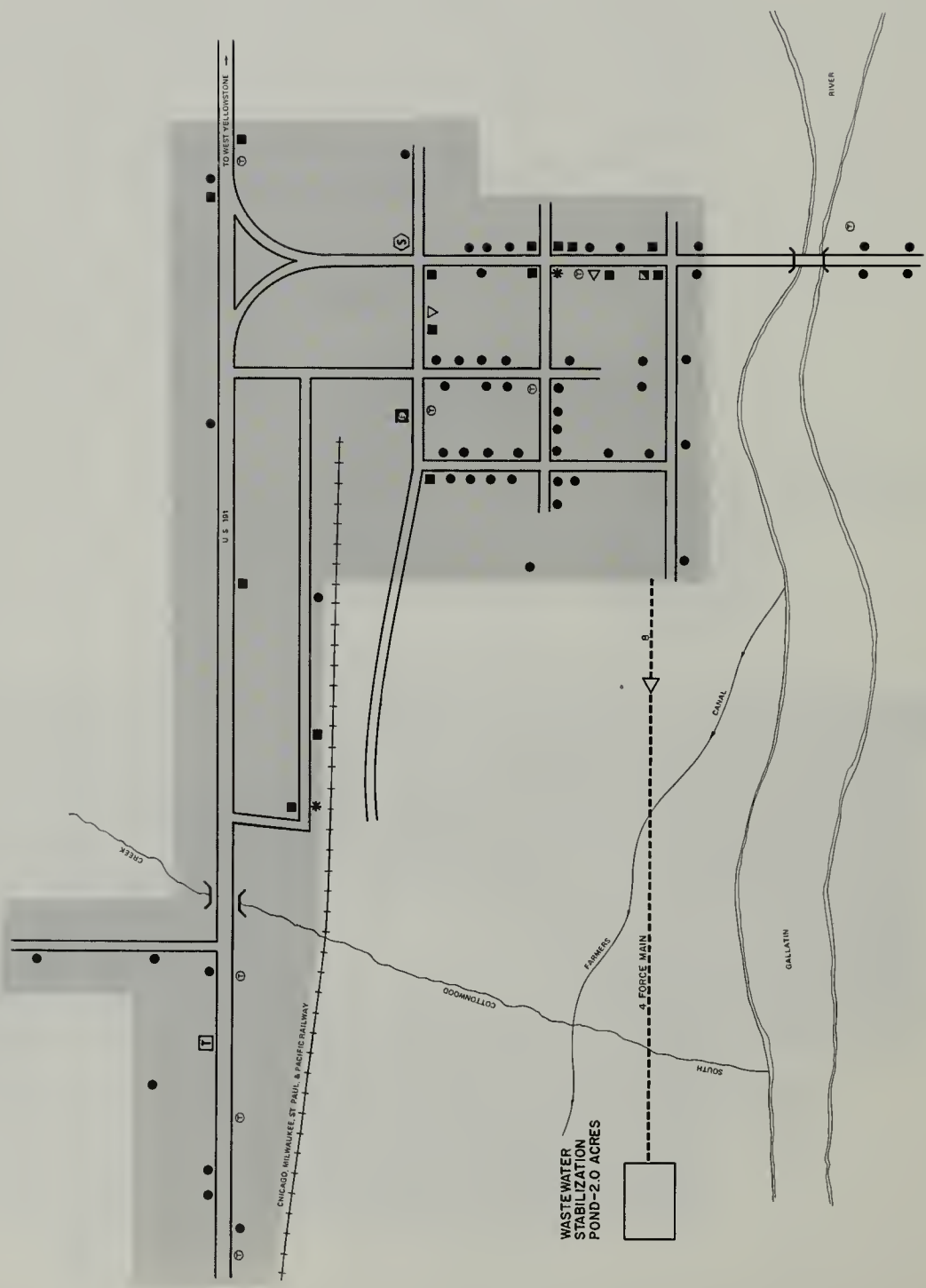
WASTEWATER
STABILIZATION
POND—50 ACRES
10 ACRE ADDITION
BY 1990



BOZEMAN HOT SPRINGS SEWER SYSTEM

SCALE
1" = 100'

MAP 20

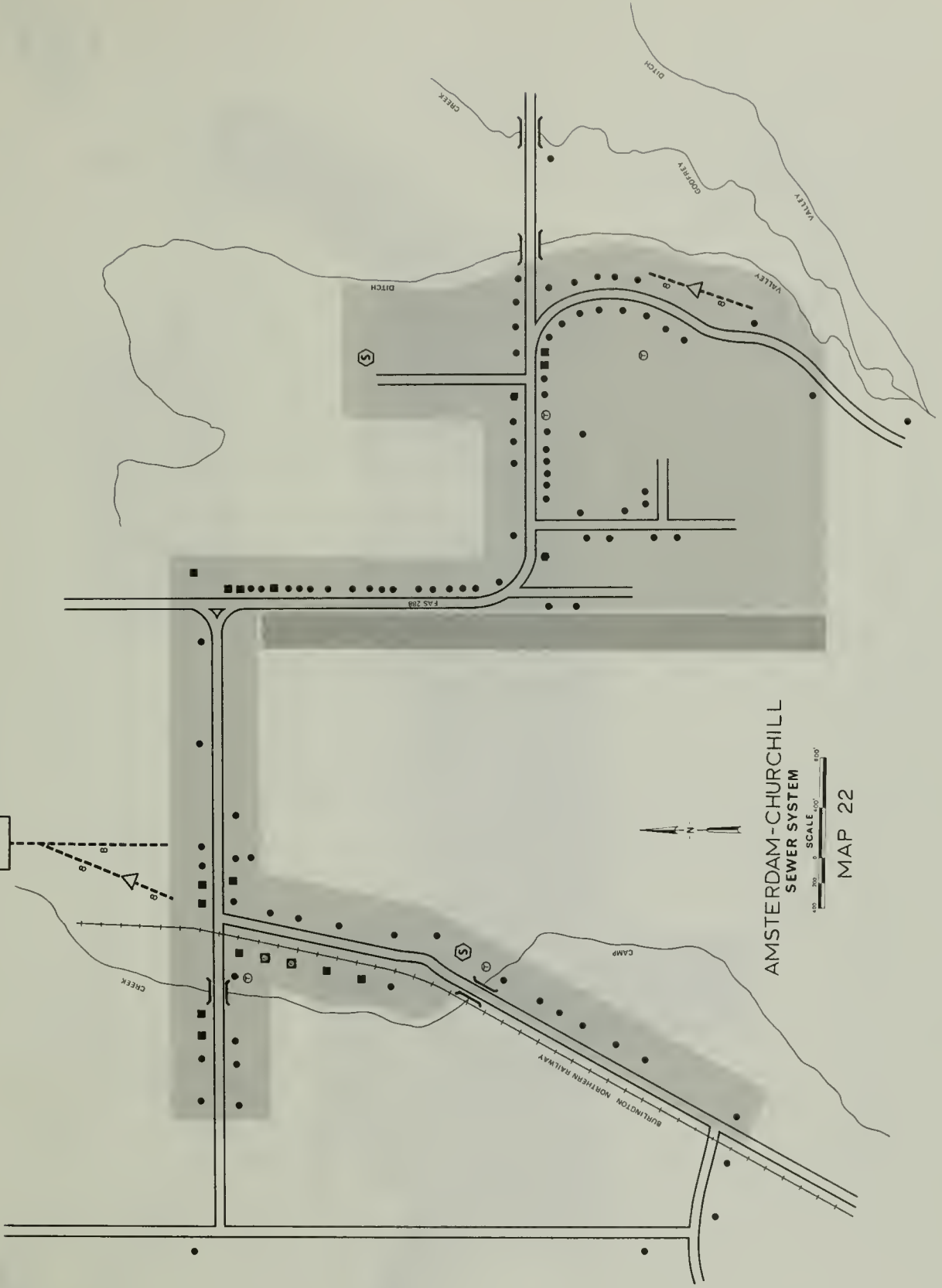
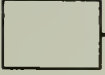


GALLATIN GATEWAY SEWER SYSTEM



MAP 21

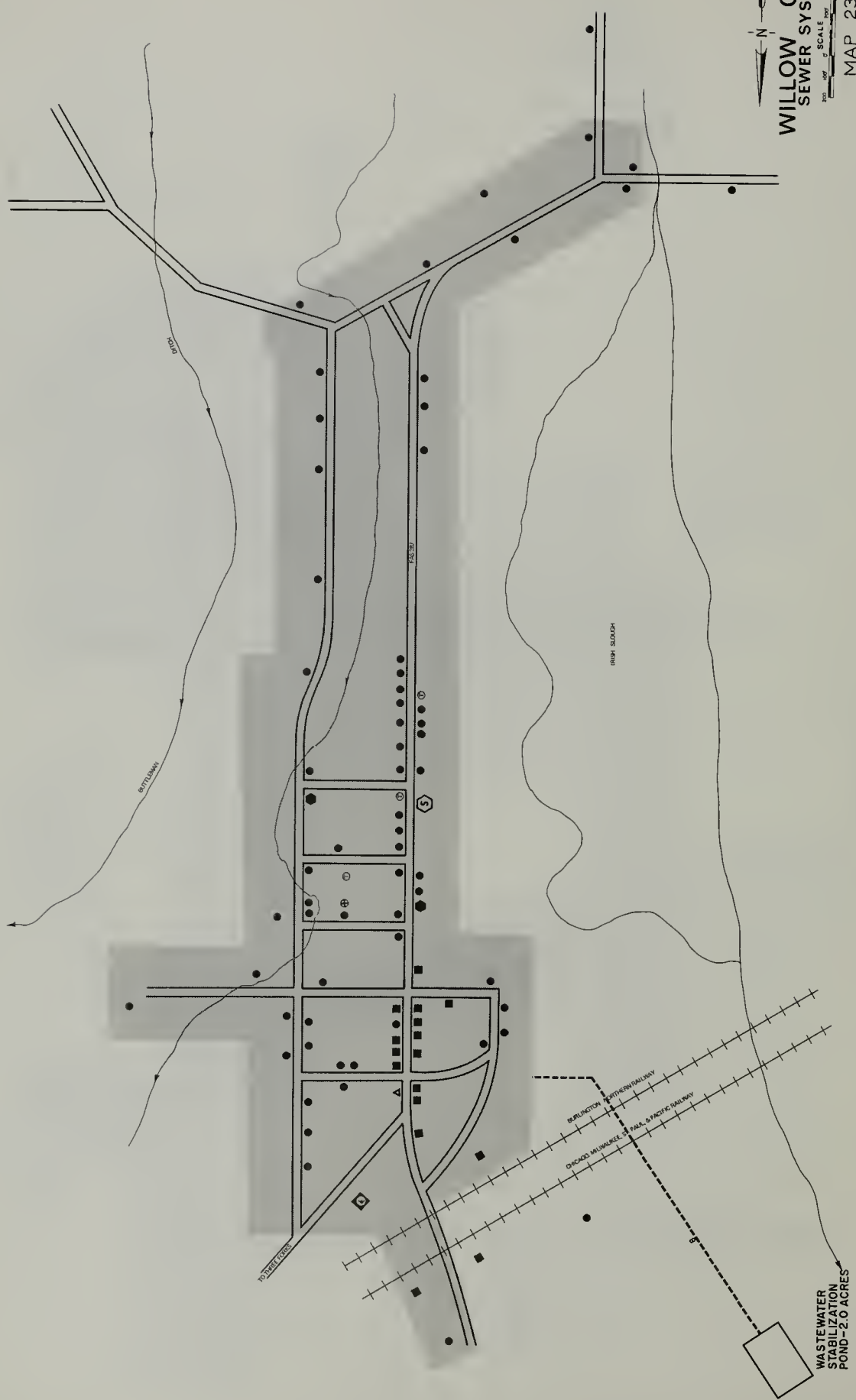
WASTEWATER
STABILIZATION
POND-4.3 ACRES

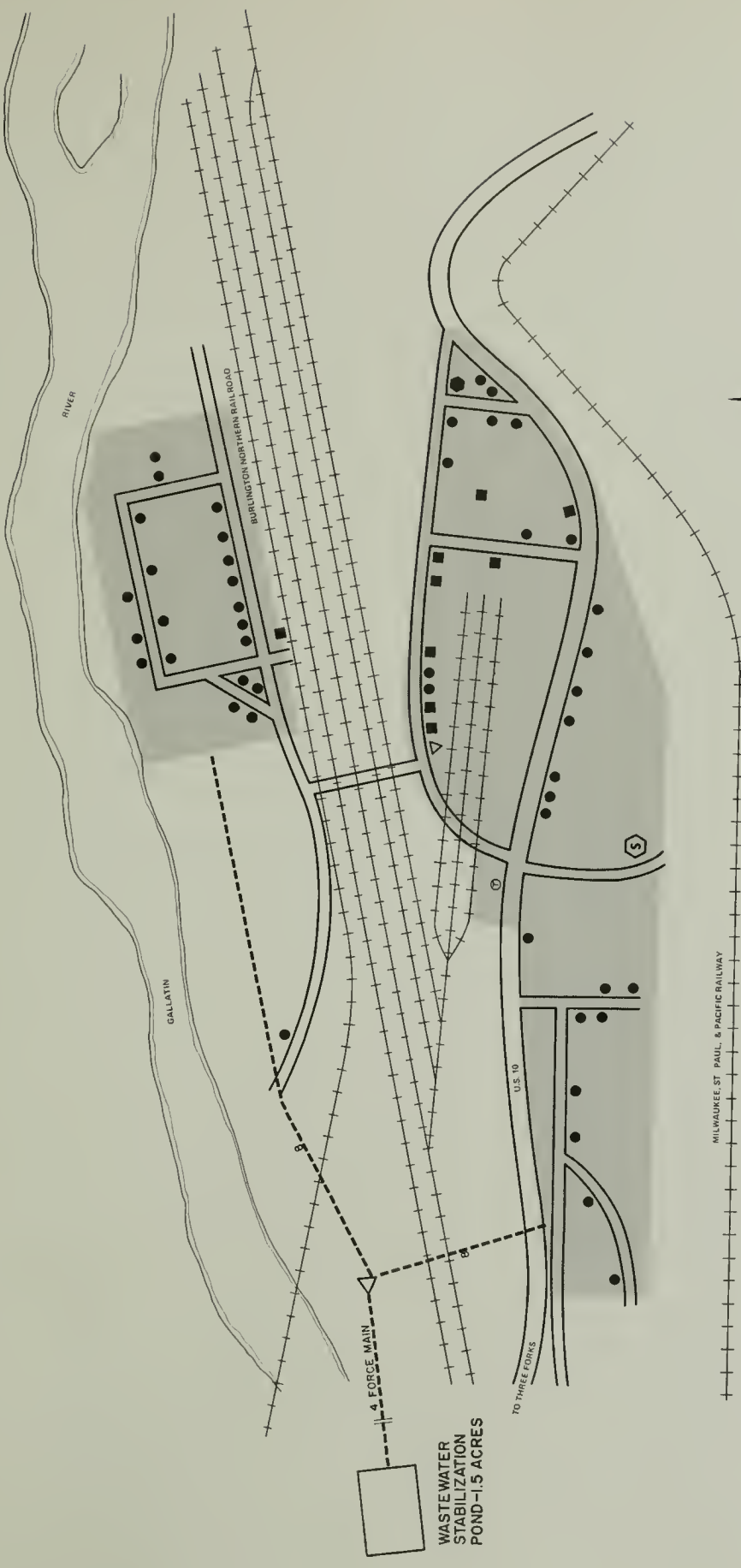


AMSTERDAM-CHURCHILL
SEWER SYSTEM

SCALE 0 100 200 300 400 500'

MAP 22





LOGAN
SEWER SYSTEM

200 400 800
SCALE

MAP 24

TO THREE FORKS

INTERSTATE 80

PARK COUNTY

MONTANA

PARK COUNTY
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CONCLUSIONS, RECOMMENDATIONS, AND PRIORITIES

Conclusions

The total population of Park County is expected to remain essentially steady during the planning period. All of the communities covered in this report, however, will experience a slight population decrease. Livingston, the largest town in the county, will experience some population increase but is not included in this study since its population is presently larger than 5,500. The population decrease for the communities covered in this study will be only a small percentage of their present population.

The systems presently in operation throughout the county are in generally good condition. Many of the smaller communities could feasibly construct community sanitary facilities, and in some cases the improvements are very much needed. Systems have been proposed for all communities in the county where feasible; however, in some cases the local demand for the facilities has not developed. Gardiner does need an adequate sewer system facility in the very near future. This community has already proceeded with the planning of this facility, and it is expected that it will be completed in the near future.

Recommendations

This plan shows the various types of improvements which the communities should be considering during the planning period. Elaborate systems are not proposed but rather those facilities necessary to provide safe and adequate community systems. It is recommended that this general plan be adopted by the governing agencies of each community. A detailed approach, which must be undertaken to insure completion of the improvements in each community, cannot be covered in a report of this type. Community leaders, however, do have several courses of action which may be taken.

Most small communities do not have the means to plan and finance complete water and sewer systems. Therefore, to enable communities to acquire such facilities, five departments of the Federal Government have legislation authorizing loans or grants for construction of public works. These agencies are:

Farmers Home Administration
United States Department of Agriculture
P.O. Box 850
Bozeman, Montana 59715

Federal Water Quality Administration
United States Department of the Interior
% Montana State Department of Health
Helena, Montana 59601

Public Health Service
United States Department of Health, Education, and Welfare
Division of Indian Health
Billings, Montana 59101

Administration for Metropolitan Development
United States Department of Housing and Urban Development
Assistant Regional Administrator
Denver Regional Office
1050 South Broadway
Denver, Colorado 80209

Economic Development Administration
United States Department of Commerce
Montana Field Coordinator
207 Medical Arts Building
Butte, Montana 59701

The legislation is constantly changing; therefore, community leaders should investigate the various alternatives and determine which program and course of action would be most beneficial to them.

Priorities

That a particular system requires immediate improvements and another system will be satisfactory for a definite period are difficult to establish. Several indicators for establishing priorities are available, however. The general health of the people is the prime consideration, and this can only be insured when safe water supplies are provided. Water supply in adequate quantities is another important factor. Waste water must be treated and disposed of by safe methods to minimize the problems of pollution and to protect public health. The total number of persons benefited by any improvement must also be considered. These basic criteria were used in establishing the following priority listing:

1. Gardiner Sewer System. A new and complete sewer system is very much needed in this community. There is sufficient population presently residing here to justify the improvement. The elimination of a pollution problem makes the project necessary. There is sufficient permanent population to make the project feasible.

2. Clyde Park Sewer System. The elimination of operational problems presently experienced with private septic tanks is a primary reason for this improvement. There is sufficient population to make the project feasible.

3. Wilsall Sewer System. There is sufficient population presently residing in this community to make central sewer system facilities feasible.

4. Cooke City Sewer System. The elimination of a potential pollution problem makes this project necessary. The number of permanent residents and the increased summer population make the project feasible.

5. Silver Gate Sewer System. Elimination of operational problems presently experienced with the private systems and the elimination of a potential pollution problem make the project necessary. The number of permanent residents together with the transient summer population make the project feasible.

6. Clyde Park Water System. Increased water supply to furnish the necessary water for high demand periods of the summer is a necessary improvement. There is sufficient population presently residing here to make the project feasible.

This list of priorities is not intended to govern the order in which action should be taken. The order merely ranks the severity of the problems and the need for improvements.

THE LAND

General Characteristics

Park County is located in south central Montana and is surrounded by Gallatin, Meagher, Sweetgrass, Stillwater, and Carbon Counties; it is bordered by the State of Wyoming on the south. The total area is 2,631 square miles of which four square miles represent water surface area. Along with many small mountain lakes, the Shields, Boulder, and Yellowstone Rivers account for most of this water surface area.

As seen by the topography on Map 1, Park County is characterized by land that changes from very mountainous areas to broad valleys of rolling agricultural lands. The county has parts of the Rocky Mountains located in all of its corners. The Crazy Mountains with peaks soaring over eleven thousand feet tower across part of the

northeast corner while the Bridger Range extends across the northwest area; the Gallatin Range covers the southwest corner and the Absaroka Mountains with Granite Peak, the highest point in Montana with an elevation of 12,799 feet, covers much of the southeastern part of the county. The population distribution lies mainly along the Yellowstone River with Livingston as the largest town and county seat.

Transportation facilities in Park County are provided by federal, state, and county roads. Interstate 90 travels east to west across the county passing through Livingston and continuing on westward to Bozeman. U. S. Highway 89 enters the county at Gardiner, follows the course of the Yellowstone River to Livingston, and then continues northward through the county to Great Falls and eventually Glacier Park. Dirt and gravel roads serve the more outlying areas and communities.

The main line of the Burlington-Northern Railroad provides both freight and passenger service to the area. The line passes through Livingston where a branch line extends south to Gardiner and Yellowstone Park. A short distance east of Livingston, another spur line extends north and terminates at the community of Wilsall. Two passenger trains, the North Coast Limited and the Mainstreeter, serve the area four times daily. The number of freight trains daily varies with the need in the county area.

Although there are no commercial airports in Park County, daily air service and connections to nation wide airlines are available at Bozeman, twenty five miles to the west. Livingston does have, however, a paved aircraft landing strip with limited servicing facilities and an airport beacon.

The Park Electric Cooperative serves the county with electric power. The two power suppliers are the Bureau of Reclamation and the Montana Power Company. Most of the power comes from the Bureau of Reclamation by way of Montana Power Company transmission lines. The Montana Power Company has substations located at Bozeman, Clyde Park, and Livingston.

Since major power producing centers and relay stations are usually located at widely separated points and provide power service to large areas, Map 2 shows the major power grid system for the entire State of Montana. Major gas transmission lines are also shown.

Mountain States Telephone Company provides telephone service throughout the county.

Land Ownership and Use

As seen on Chart 1, there are three major types of land owners in Park County. The largest segment of land, fifty one percent or 1,344 square miles, is federally owned. Forty seven percent, or 1,230 square miles, is under private ownership; small amounts of municipal and county land are included in this category. The State of Montana owns two percent, a total of fifty seven square miles.

Much of the county is devoted to raising livestock, but the county does produce significant amounts of agricultural crops. Fifty two percent of the county is in farms and ranches. Forests account for forty two percent of the land use, and most of this is in the Gallatin National Forest. The remaining six percent of the land includes such things as town sites, transportation routes, and some commercial uses. This six percent also includes the four square miles of water in the county.

Natural Resources

Since the discovery of gold along Emigrant Gulch in 1863, mining has played an important role in the settlement and economy of Park County. Presently the high cost of extracting the remaining gold has limited the production. The Henke Beer and the W. M. Clayton mines are two placer mining operations still active.

Non metal materials produced include stone from the Livingston Marble and Granite Quarry. This open pit operation extracts travertine, ashlar, and cut stone.

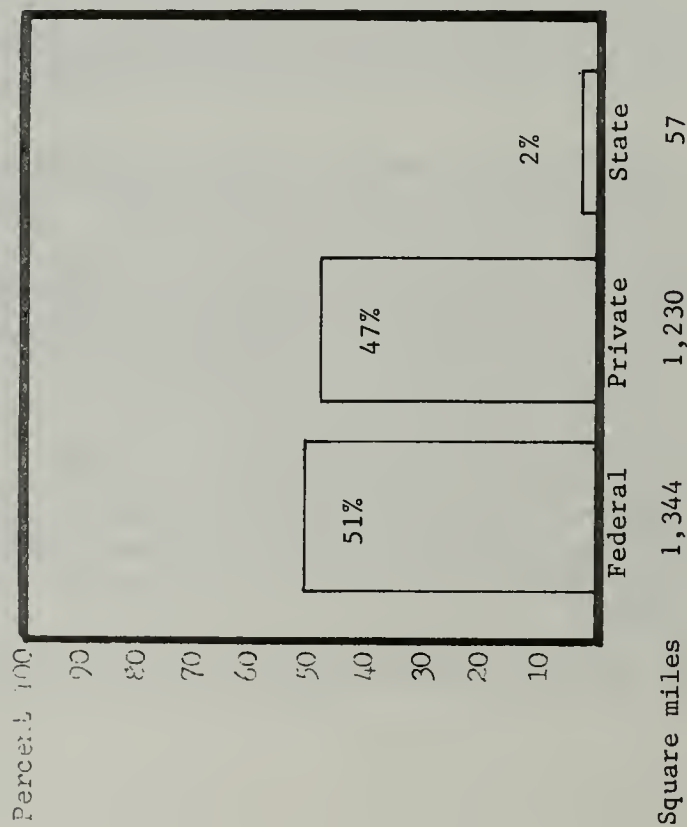
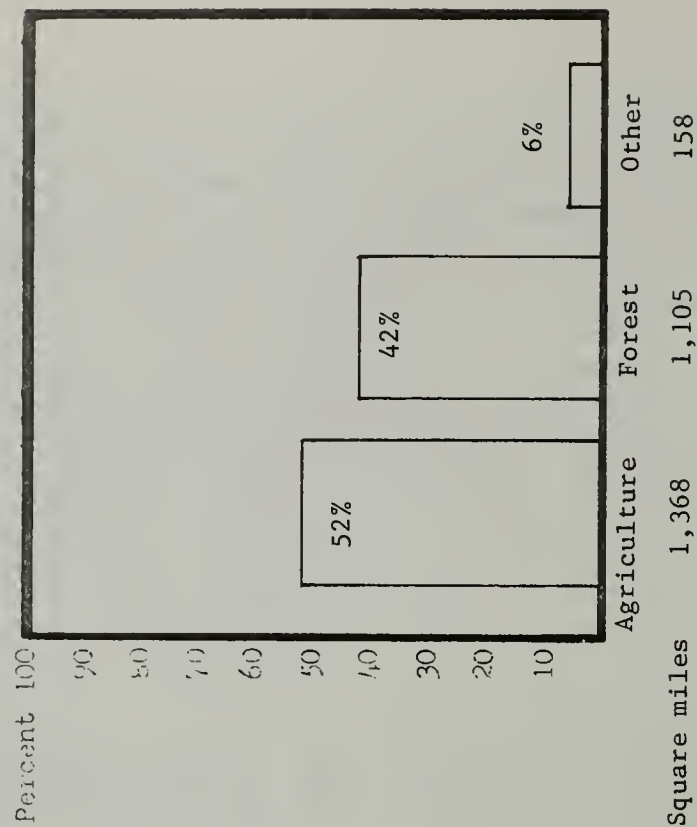
Sand and gravel are also produced but mostly on a volume dictated by needs for local road construction.

Coal reserves are located in the Electric Field in Park County but in limited amounts. The beds are three to five feet thick and are sub-bituminous rank in nature. Coal mining is not considered profitable at this time and there are, accordingly, only limited mining operations.

Agriculture developed almost concurrently with the early mining settlements. Livestock was the main activity and has remained thus at the present time with the rolling foothills and grasslands of the southern and central area of the county lending themselves to extensive ranch operations. Small grains with good production yields are also raised throughout the county.

Timber operations in the Gallatin National Forest play an important

Chart 1

Land Ownership
Park CountyChart 2
Land Use
Park County

Sources: 1. The Montana Almanac, 1959 - 1960
 2. Forest Service, U. S. Department of Agriculture

role in the county. Four species of trees, Douglas fir, western larch, Engelmann spruce, and Ponderosa pine, predominate in the forests of the county. Douglas fir accounts for nearly one third of the sawtimber (those trees over eleven inches in diameter) and with the other three major species accounts for about four fifths of the total sawtimber volume. Important lumber products on the Montana market are mine timbers, railroad ties, posts, and poles. The many secondary products include such pre cut items as log homes and processed products like fireplace logs and doors. In fiscal year 1969 the national forest yielded receipts of \$76,669.00 from the Forest Service for timber sold, grazing rights, land use, recreation, power permits, and mining leases.

Many facilities prevail for recreation in the county. Swimming, hunting, fishing, hiking, and snowmobiling are just a few of the summer and winter sport activities offered to visitors or county residents. Deer, elk, moose, bear, and mountain goat and sheep make their homes in the mountains and valleys and provide exciting hunting. Upland game birds and water fowl such as grouse, ducks, geese, and pheasants are also available.

Abandoned gold mines, ghost towns, and crumbling relics of early pioneers lure many weekend adventurers.

In the southern part of the county the Absaroka Primitive Area and the Beartooth Primitive Area provide original wilderness to the hikers and pack horsemen. Grasshopper Glacier with its ice encased pre-historic grasshoppers lies northeast of Cooke City near Montana's highest point, Granite Peak. Yellowstone Park covers almost the entire southern border of the county.

With the interest in America's outdoors expanding, the excellent recreational facilities of Park County will also become recognized and begin to play an increasingly important role in the county's economy.

Soils

Generally, the soils of Park County are used for agricultural purposes. The southern half of the county with the productive valley of the Yellowstone River provides thousands of acres of excellent grazing for large numbers of cattle and sheep. In the northern half of the county the Shields River valley also offers large areas of productive croplands and superb grazing land. Most of the southeastern part is in forests with the highest elevations too rocky to support any life at all.

Soils are covered in more detail later in this report.

Water

The watersheds in thickly forested mountain slopes of the county play an important part in the water resources of the area. Most of the forests in the southern half drain into tributaries of the Yellowstone River, part of the Missouri River drainage system. Most of the northern half of the county drains into the Shields River which also enters the Yellowstone east of Livingston. Another tributary, the Boulder River, drains much of the land on the eastern border of the county.

Both ground and surface-water resources are covered in detail later in this report.

THE PEOPLE

Population

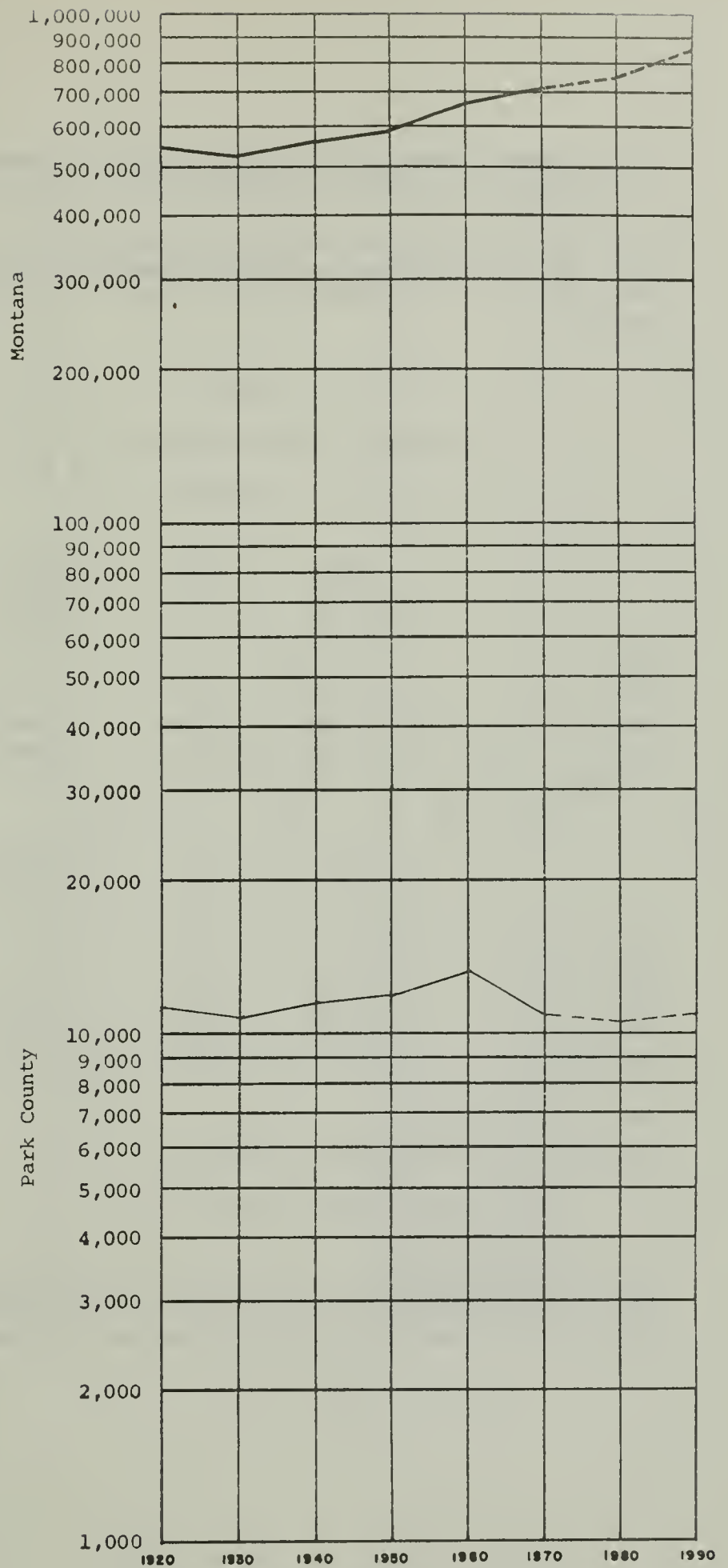
For analytical and projective purposes, it is necessary to study the population history of Park County to find out what has happened and what is going to happen. Chart 3 graphically shows the growth of the county as compared with that for Montana and indicates the future growth for both.

Population in the county has fluctuated over the past fifty years. During that period three census reports indicated increases while the remaining two reported losses. In spite of the growth periods, the 1970 estimated population is three hundred less than the population in 1920. The largest decrease occurred between 1950 and 1960 resulting in a loss of almost seventeen percent.

The county was classified as a semi rural area in 1960 containing at least one incorporated town of 2,500 or more persons but included neither in nor near a Standard Metropolitan Statistical Area. As indicated in Table 1, the rural population increased at a greater rate between 1950 and 1960 than did the urban. Farm population actually declined in number during the period while substantial growth occurred within the rural non farm areas. During the past ten years population dropped sharply in the county. The estimated loss in the urban area was only six percent as compared to a thirty six percent decrease in the rural segment. Over the twenty year reporting period the urban sector has continued to represent a larger portion of the total population. The percentage rose from two thirds in 1950 to a present

CHART 3
COMPARATIVE
POPULATION
TRENDS

Park County and
Montana



Sources:

1. U.S. Census of Population
2. Intermountain Planners, Inc.

three fourths. The percent of those living on farms has declined while a slight gain occurred for the rural non farm population.

The total population increased by 1,169 persons between 1950 and 1960. Chart 4 indicates that the increase is a result of a net migration loss of 161 persons and an excess of 1,330 births over deaths.

TABLE 1
Urban-Rural Population Changes for Park County
1950-1970

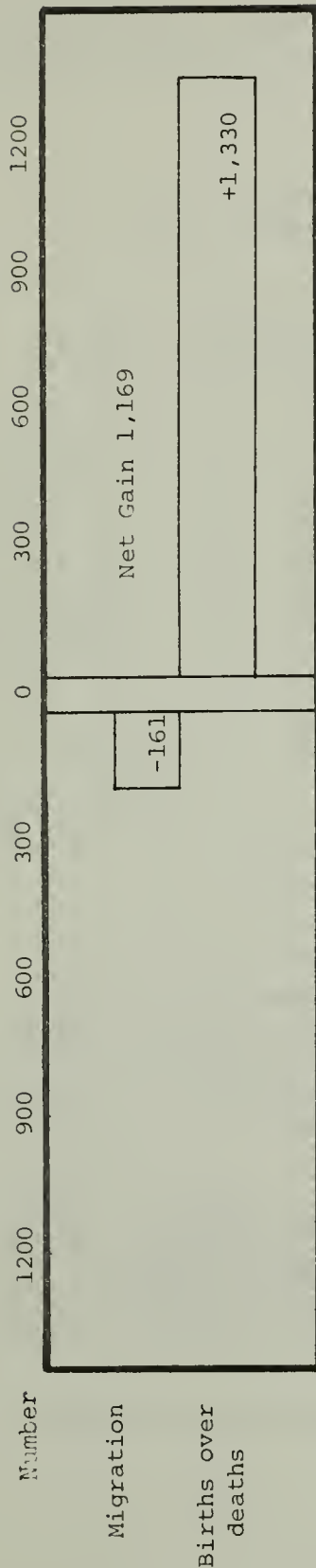
	<u>1950</u>	<u>1960</u>	<u>Changes</u> <u>Number</u>	<u>1950-1960</u> <u>Percent</u>
Total	11,999	13,168	+1,169	+ 9.7
Urban				
(Inc. Towns)	7,963	8,482	+ 519	+ 6.5
Rural	4,036	4,686	+ 650	+16.1
Farm	2,335	1,736	- 599	-25.7
Non Farm	1,701	2,950	+1,249	+73.4
	<u>1960</u>	<u>1970</u>	<u>Changes</u> <u>Number</u>	<u>1960-1970</u> <u>Percent</u>
Total	13,168	11,000	-2,168	-16.5
Urban				
(Inc. Towns)	8,482	8,000	- 482	- 5.7
Rural	4,686	3,000	-1,686	-36.0
Farm	1,736	1,200	- 536	-30.9
Non Farm	2,950	1,800	-1,150	-39.0

Sources: 1. U. S. Census of Population
2. Intermountain Planners, Inc.

The 1950 to 1960 change in sex composition is shown in Chart 5. The ratio between males and females remained stable over the ten year period and will continue to do so throughout the planning period.

CHART 4

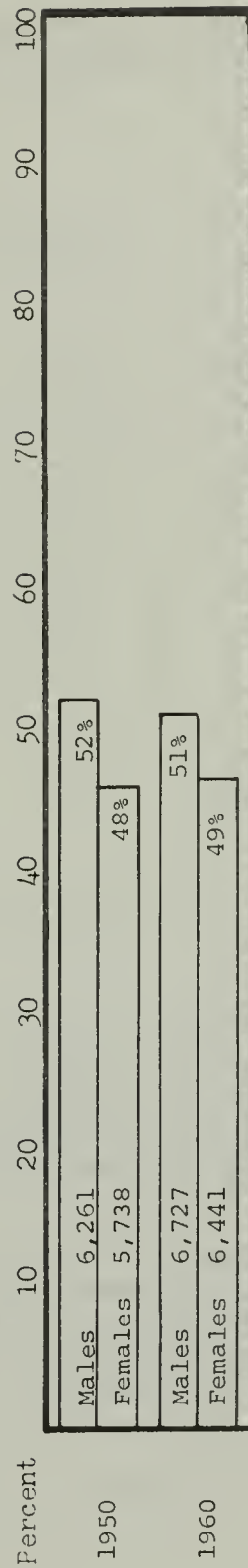
Population Change
Park County 1950 - 1960



Source: Net Migration of Population, 1950-1960 by Age, Sex, and Color,
U. S. Department of Agriculture

CHART 5

Population by Sex
Park County 1950 - 1960



Source: U. S. Census of Population, 1950-1960

The age distributions by sex for 1950 and 1960 are shown in Table 2. As indicated, growth occurred within the younger and the older age groups.

TABLE 2
Age & Sex Composition of Park County

Age Group	1950		1960	
	Male	Female	Male	Female
Under 5	642	622	720	625
5-14	968	953	1,323	1,330
15-19	354	358	461	483
20-24	356	357	308	323
25-34	894	888	763	754
35-44	895	804	882	883
45-54	778	685	839	724
55-64	716	574	635	563
65-74	477	338	529	490
75 +	181	159	267	266
Total	6,261	5,738	6,727	6,441

Source: U. S. Census of Population, 1950-1960

A total of nine towns and communities were studied in Park County. The list includes the incorporated town of Clyde Park and the nine unincorporated communities of Cooke City, Emigrant, Gardiner, Jardine, Pine Creek, Silver Gate, Springdale, and Wilsall. The community of Miner was also studied but was not included within this report because of insufficient size and development.

Because of the lapse of time since the 1960 Census, current population estimated had to be derived from several sources in the field. Surveys and interviews were conducted to determine what now exists and what is expected in the future. Table 3 indicates the past population experience and the future projections for each town and community. As indicated, no population growth is expected for any community in the county.

Gardiner will remain the largest community in the county throughout the

twenty year planning period; although, a seven percent population decline is expected to occur by 1990 resulting in a decrease of fifty persons.

TABLE 3

Population Forecast for Towns and Communities

Park County

	<u>1950</u>	<u>1960</u>	<u>1970</u>	<u>1975</u>	<u>1980</u>	<u>1990</u>
Clyde Park	280	253	225	215	200	170
Cooke City	100	30	40-150*	35	35	30
Emigrant	30	25	20	18	15	15
Gardiner	425	650	700	690	675	650
Jardine	115	100	30	25	20	20
Pine Creek	NA**	NA	40	40	40	35
Silver Gate	35	20	50	48	45	40
Springdale	75	50	33	30	25	20
Wilsall	275	200	250	250	240	230

* Summer Population

** Not Available

Sources: 1. U. S. Census of Population, 1950-1960

2. Intermountain Planners, Inc.

The communities of Wilsall and Clyde Park are the only remaining areas of any size. As indicated, the number of persons in each will also decrease. The Cooke City permanent population is expected to remain fairly stable, but it is difficult to project the number in the summer population.

The population figures reflect only those factors and trends for which information is available. New technological advances, new industries, or other unforeseen events may alter these projections. If such an event occurs, the areas affected should be studied in light of the new conditions.

Housing

In 1960 there were 4,597 housing units within Park County. Chart 6 indicates that almost two thirds of all homes, mainly located in Livingston, were of the urban type while twenty six percent were in rural non farm areas. The remainder were represented by farms. The median housing unit size was 4.40 rooms per unit, and the median household size per occupied unit was 3.03 persons. Of those units, fifty nine percent were owner occupied while one third were used for rental purposes. Chart 7 indicates that six percent were vacant. The condition of housing in 1960 is reflected in Chart 8 which indicates that eight percent were in need of replacement while one home in five needed repair. The remainder were classified as sound.

In 1960 almost three fourths of all homes were served by a public water system or by a private company. Those served included almost all the urban homes, again mainly those in Livingston, over one third of the rural non farm homes, and only one percent of the farms. About one fifth of the homes relied on individual wells for water while eight percent used some other water source.

HOUSING Park County

Chart 6
Housing Classification

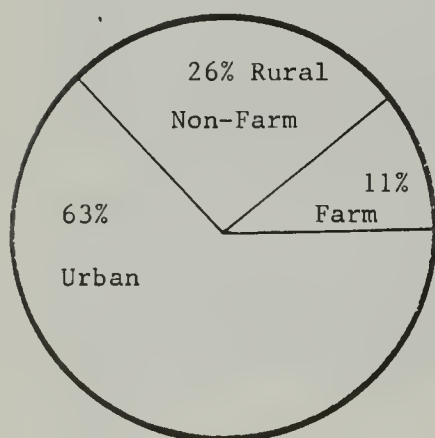


Chart 7
Housing Tenure

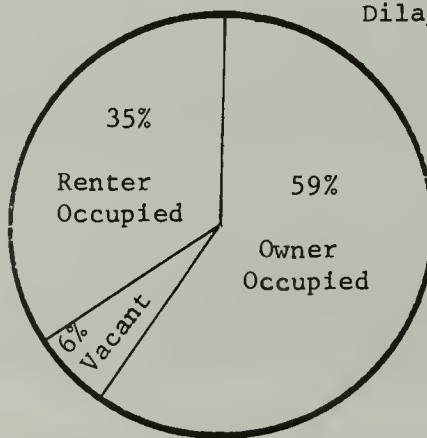
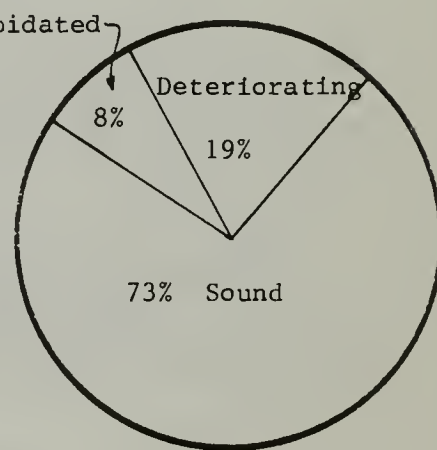
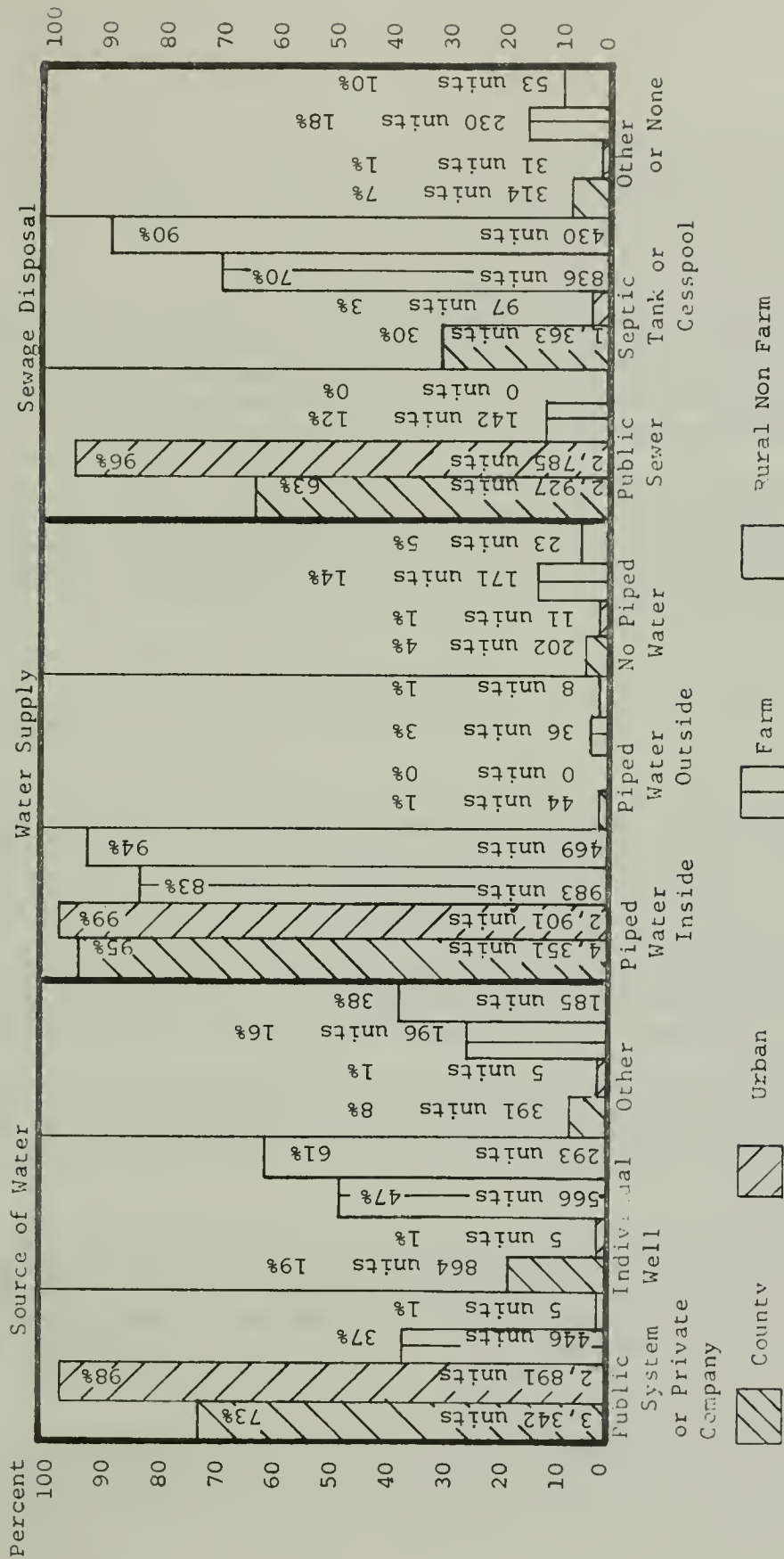


Chart 8
Housing Condition



Source: U. S. Census of Housing, 1960

CHART 9
Sewer and Water
Park County, 1960



Source: U. S. Census of Housing, 1960

Only four percent of the homes did not have piped water in 1960. This figure included one percent of the urban homes, one rural non farm home in seven, and only five percent of the farms.

Two thirds of the homes had public sewer service in 1960. The figure included almost all urban homes and only twelve percent of the rural non farm homes. Generally, the farms relied on septic tanks and cesspools for sewage disposal as did seventy percent of the rural non farm homes. Only seven percent of the homes relied on a method other than a public sewer system, septic tank, or cesspool.

The percentage of homes served by a water and sewer system in the county is impressive. But when it is understood that the of Livingston accounts for the majority of housing units, the remaining homes take on a greater significance. The housing data indicates that improvements are needed in the rural non farm areas.

THE ECONOMY

Labor

The economy of Park County is dependent on the people because of their role as both producers and consumers of goods and services. The following economic analysis is concerned primarily with the total economic spectrum and how it may affect the future of the area.

Changing economic conditions can have either a good or a bad effect in terms of population growth, ability to provide for public improvements, or in determining the general overall living environment.

Employment rose by almost three percent in the county between 1950 and 1960 while the population increased by almost ten percent. The county employment increase is contrasted with a six percent increase for Montana.

The past employment change by major industry groups is shown in Chart 10. During the 1950-1960 period the county had the third highest population gain in southwest Montana. Employment did not rise at a similar rate. A diminished labor demand for men in addition with an over expansion of the female labor force substantially advanced the unemployment rate. The share of positions held by women increased substantially during the period.

Reversing the performance for the previous reporting period, the transportation and utilities group now accounted for the majority of all job losses. Railroad employment, accounting for over eighty

percent in the group, represented the majority of workers. The remainder were employed in the trucking, communications, and utilities groups.

Livingston served as the major shopping center for Park and Sweetgrass Counties. This is reflected in the increase in the trade and the services and finance industry groups. The latter industry represented the largest labor group following transportation and utilities. Within this group, almost one worker in four was in the personal services field while another one fourth represented the educational profession. Professionals together with insurance and finance workers accounted for an additional twenty percent.

Retail workers represented over half of the workers in the trade industry group, thus indicating the marketing center of Livingston where complete shopping facilities are available. Another one in four members of the group worked in either a bar or a restaurant.

Manufacturing employment displayed new growth by accounting for over one third of all new jobs. Almost two thirds of those employed in the group were engaged in the production of lumber products. An additional sixteen percent were employed in the food production industry.

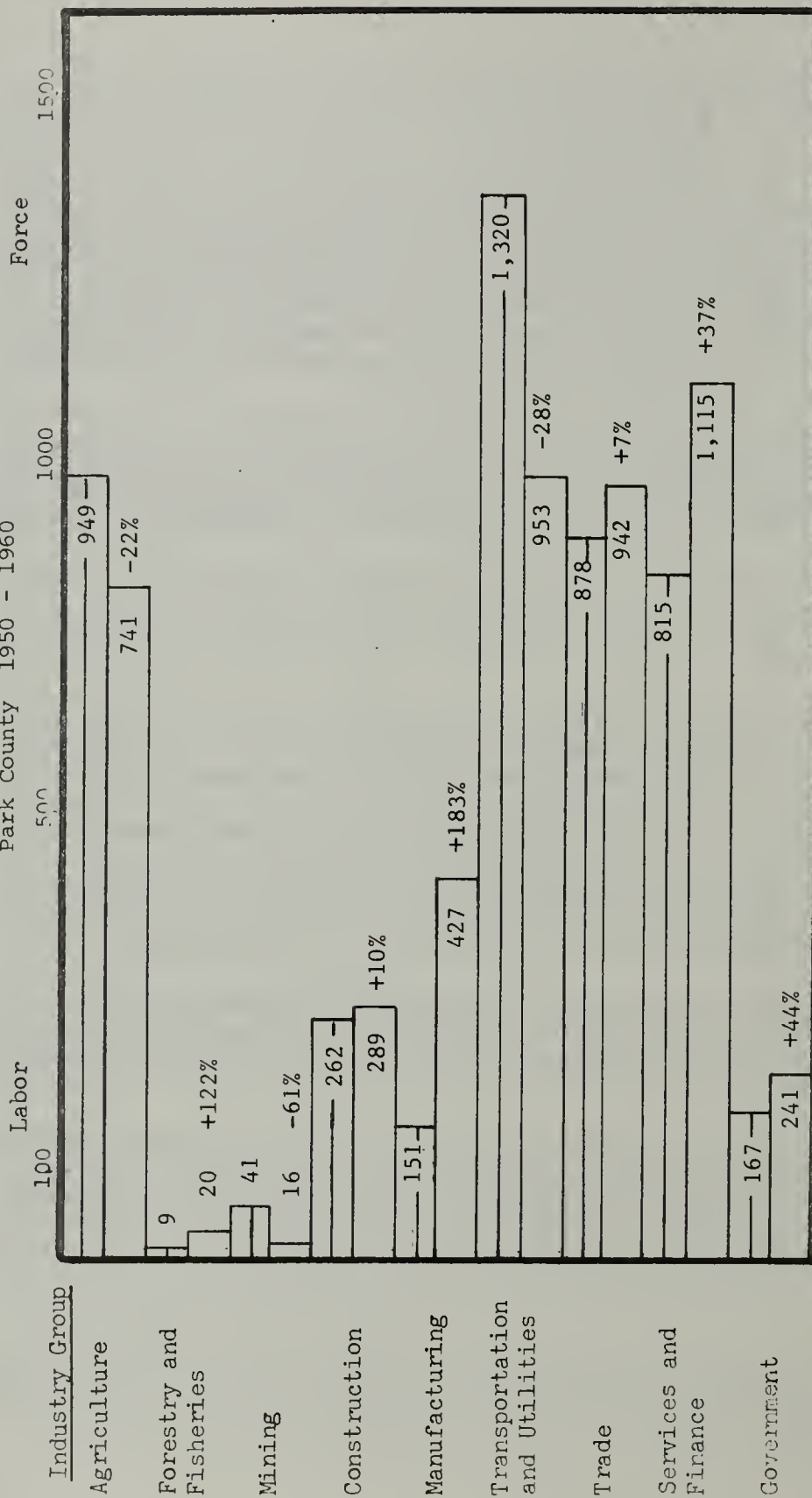
Agricultural employment declined by twenty two percent over the ten year period. In spite of the loss in that labor force, however, the industry still played a major economic role in the county.

The percentages for employment by industry group shown in Table 4 give an insight into local employment characteristics. The table shows the relative weight of each industry group in the county and offers a comparison with that existing in 1960 for the State of Montana and the United States.

The services and finance group represented the largest group of employees, twenty three percent of the total. The employment rate was below that for the state but forty four percent higher than that for the nation.

The trade and the transportation and utilities group each equally represented about one fifth of the labor force. The trade rate was similar to that for Montana and the United States, but the transportation and utilities group had a rate far exceeding the statewide or national figures.

CHART 10
Employment Change by Major Industry Group
Park County 1950 - 1960



1950 Total Employment

1960 Total Employment
Includes Some Industries Not Reported

Source: U. S. Census of Population, 1950-1960

TABLE 4

Percent of Total Employment by Industry Groups

Park County, Montana and United States

1960

	<u>Park County</u>	<u>Montana</u>	<u>United States</u>
Agriculture	15	17	11
Forestry and Fisheries	1	1	1
Mining	1	3	1
Construction	6	7	5
Manufacturing	9	10	27
Transportation and Utilities	20	9	7
Trade	20	21	19
Service and Finance	23	26	16
Government	5	6	13
Total	100	100	100

Source: U. S. Census of Population, 1960

Employment data published by the Employment Security Commission of Montana indicates a general reduction in the total work force. The overall reduction possibly is indicative of the rising influence and expansion of the Bozeman market area.

Wood products manufacturing and tourist services appear to be the industrial sections where future growth may appear.

Agriculture

A farm is defined by the United States Census as a place having at least ten acres of land devoted to agriculture and selling at least fifty dollars worth of agricultural products annually. According to Chart 11, there were 425 farms in Park County in the above category in 1964, seven percent fewer than there were in 1959.

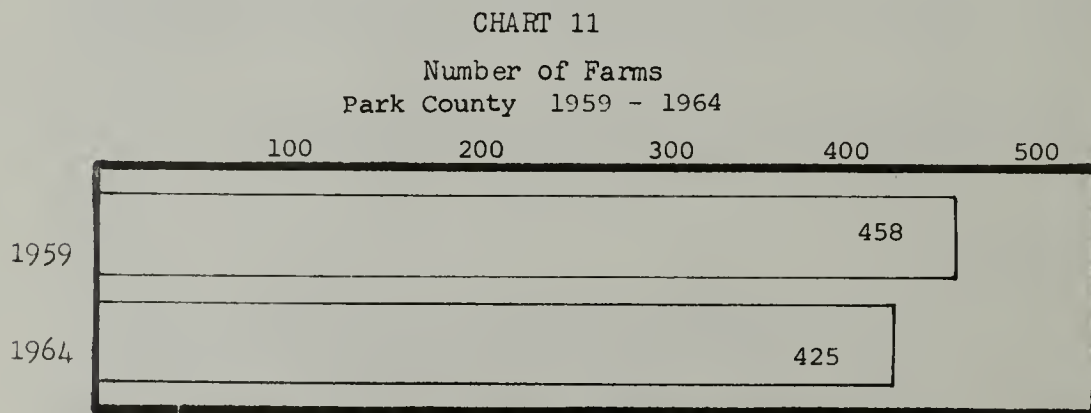
The 1964 classification of farms by type was as follows:

Field crop farms other than vegetables, nuts, and fruit	33
Cash grain	33
Dairy farms	17
Livestock farms other than poultry and dairy	277
General farms	26
Miscellaneous and unclassified	72
Total	425

Of the total number of farms, forty two were classified as part time and fifteen percent were classified as being operated by semi retired persons.

The average size farm in 1964 was 2,073 acres, and almost two thirds of the total were livestock producers. At that time one farm in eight was operating below a full time level. Chart 12 indicates that over half of all farms were in excess of one thousand acres in size while almost one third were under five hundred acres.

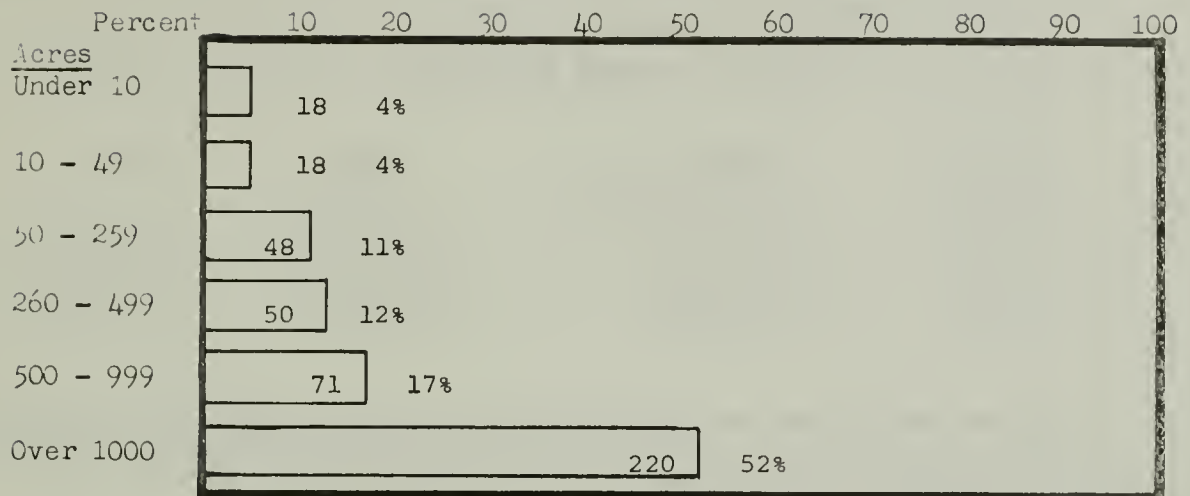
The value of products sold by the number of farms is indicated in Chart 13. Just less than half of the farms received over \$10,000 for



Source: U. S. Census of Agriculture, 1964

CHART 12

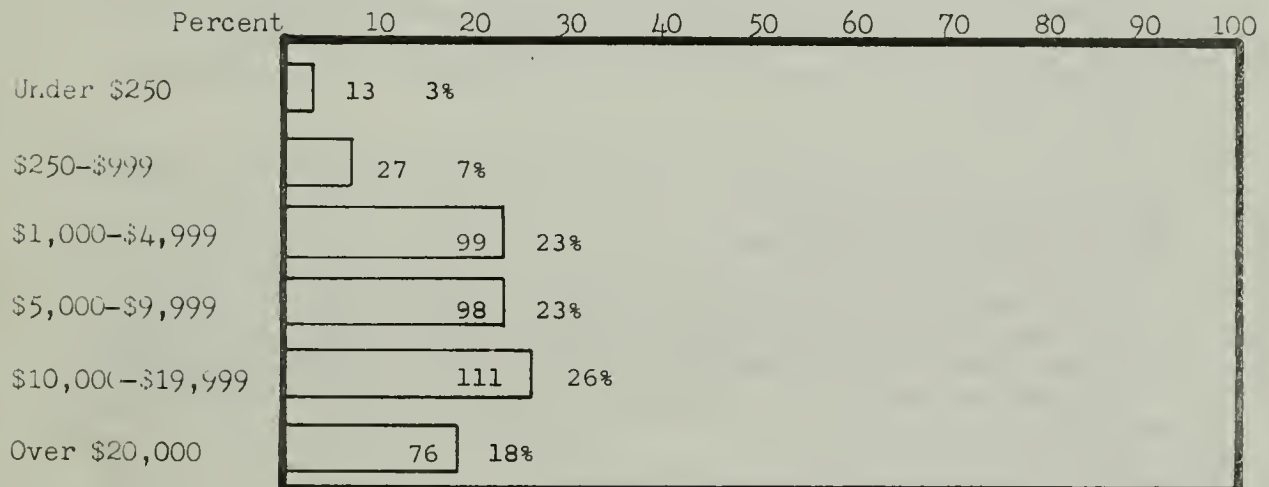
Farms by Size
Park County 1964



Source: U. S. Census of Agriculture, 1964

CHART 13

Number of Farms by Value of Farm Products Sold
Park County 1964



Source: U. S. Census of Agriculture, 1964

products sold while almost one in five reported sales in excess of \$20,000. One third of all farms at that time received under \$5,000 for all products sold.

Cash receipts data for the county from 1964 to 1967 is as follows:

<u>Year</u>	<u>Livestock</u>	<u>Crops</u>	<u>Total</u>
1964	\$3,453,100	\$1,098,000	\$4,551,100
1965	\$4,221,900	\$1,039,500	\$5,261,400
1966	\$4,882,600	\$1,192,300	\$6,074,900
1967	\$4,654,300	\$1,420,700	\$6,075,000

Livestock sales played a major role in the agricultural portion of the economy. Over the four year reporting period about three of every four agricultural dollars resulted from the sale of livestock products.

Agriculture will continue to intensify throughout the planning period. The result will be fewer but larger farms with the majority devoted to cattle raising.

THE GOVERNMENT

Before any meaningful consideration can be given to major capital improvement projects, it is necessary to study the governmental organizations in Park County and to analyze their economic structure. At present there are two separate, local governmental units in the county involved within the scope of the water and sewer study. Included are the incorporated city of Clyde Park and the government of Park County.

A Board of County Commissioners presided over by a chairman governs the county. The incorporated municipality is governed by a mayor council form of government.

In financing capital improvement projects, the incorporated municipality has power to bond and raise the necessary moneys for funding projects. The unincorporated small town does not have similar power and, therefore, must rely on financing projects through the county government.

Table 5 indicates the financial condition of each unit of government in 1960.

TABLE 5

Financial Status of County Government and Incorporated Cities

Park County 1969*

	<u>Revenue</u>	<u>Expenditures</u>	<u>Assessed Valuation</u>
Park County	\$4,225,286.89	\$2,240,700.47	\$45,510,632.00
Clyce Park	7,873.55	6,966.26	295,479.00

* There are several methods presently available to communities for financing water and sewer systems:

1. Incorporated Cities and Towns may use Municipal Bonds, Municipal Revenue Bonds, and Special Improvement District Bonds.
2. Unincorporated Towns may use Rural Special Improvement District Bonds and County Water and Sewer District Bonds.
3. Incorporated Cities and Towns and adjacent unincorporated areas may use Metropolitan Sewer District Bonds.

Source: Information received from each governmental unit

THE WATER RESOURCES

General

The water resources of any area are one of its most important assets. Montana is fortunate in that water is in abundant supply over much of the state. This is especially true in the mountain areas and along the major drainages. Water is essential for many human needs with individual consumption and sanitation being foremost. Industrial and agricultural uses of water are perhaps next most important. The recreational use of water has also become a significant factor in modern day living.

In his use of this resource, man in the past has polluted much of the available fresh water and degraded it to the point where it is unfit for many or all uses. Careful planning for the efficient use of water

resources can avert inconveniences caused by pollution.

Water resources, therefore, are an important consideration in the comprehensive planning for community water and sewer systems. In the following portion of this report the existing water resources of the planning area will be briefly reviewed. The discussion will be specifically concerned with the occurrence and availability of both surface and ground water. Also important, and included in Appendix I, are the specific laws and policies of the State of Montana concerning surface and ground-water resources. "Water Quality Criteria," "Water Use Classifications," and "Policy Statements" adopted by the State Department of Health are discussed in detail. Table A in Appendix I outlines present day water quality standards as set forth by the United States Health Service.

Surface-Water Resources

Park County has an extensive drainage system which has primary characteristics of mountainous topography. The county is surrounded by mountainous terrain with portions of four mountain ranges predominating. The Absaroka, Gallatin, and Bridger Ranges occupy the southeastern, southwestern, and northwestern portions of the county respectively, and a portion of the Crazy Mountains occupies the extreme northeastern area of the county. The mountainous portions of the county are heavily timbered while the Yellowstone River and Shields River valleys are the major timber free areas.

The wide variations in elevations add to the complex surface drainage system. The highest point in Montana, 12,799 foot Granite Peak, is located in the Absaroka Range and elevations in excess of eleven thousand feet above sea level occur in the Crazy Mountains. The lowest elevation in the county occurs where the Yellowstone River flows into Sweet Grass County near Springdale. The elevation at this point is just over four thousand feet above sea level.

Many streams and rivers make up the complex drainage system for Park County. Major streams making up the system are the Yellowstone River and the Shields River. The Yellowstone River heads in Yellowstone National Park and flows in a northerly direction to a point near Livingston where it turns and flows easterly before leaving the county at Springdale. The Shields River heads within the county near Wilsall and flows in a southeasterly direction to its confluence with the Yellowstone River just east of Livingston. The Yellowstone River is the eventual recipient of all drainage from Park County.

The above mentioned streams and their tributaries provide a yearlong source of water for irrigation, livestock, and domestic needs. Many

of these streams have gaging stations installed by the United States Geological Survey where flow measurements are taken and recorded at regular intervals. Table 6 includes available data on the drainage area, discharge, and runoff for each gaging station pertinent to Park County.

Many small reservoirs provide water storage for various uses in Park County. The Montana Water Resources Board has published a list of information for all dams and reservoirs which store over fifty acre feet of water. Where the information was available, this list also includes data for privately owned dams and reservoirs. For more detailed information on the irrigation facilities and the use of small storage reservoirs in Park County, the Water Resources Board should be contacted.

The climate varies considerably from one area to another because of the wide range of topographic conditions, and the effect that this topography has on the climate is very important to the water resources. Prevailing west to southwest winds flowing across the mountains provide the highest annual precipitation values. Average annual precipitation values at the lower elevations in central Park County are considerably less.

As an example of the net effect of these conditions, a precipitation measuring station at Jardine in the mountains of extreme southern Park County recorded a 1969 annual precipitation of 25.80 inches. Records indicate that this is a normal figure for the Jardine area. A station located near Livingston, on the other hand, records yearly averages of between thirteen and fifteen inches. In the northern portion of Park County a precipitation measuring station located at Wilsall recorded a near normal 1969 annual precipitation value of 20.43 inches.

In general, precipitation occurs as steady rains in the spring months of April through June, intermittent showers throughout the summer and early fall months, and as snowfall during the winter months. The majority of the precipitation in the lower valleys and agricultural areas occurs during the growing season. Precipitation in the mountainous areas is fairly steady throughout the year. Much of the precipitation during the winter months occurs as snowfall, and the resulting heavy snowpack produced in the high mountains each year contributes significantly to the water resources. Snow begins to accumulate in November in the higher mountain valleys and continues to build up until late March or early April. Portions of the high mountain snowpack in Park County and in other adjacent drainage areas remain until the warm temperatures of late spring and early summer begin to melt them. The runoff from the snowpack at this time of the year coincides with the period of maximum demand for water in the

TABLE 6
Stream Gaging Stations

Stream	Gaging Sta. Location	Drainage Area (sq mi)	No. of Gages	Discharge (cfs)			Years Averaged	Runoff-1000 Acre-Ft)		
				Max.	Date	Min. Date		Max.	Date	Min. Date
1. Yellowstone River	At Corwin Springs	2,623	1	32,000	6/14/18	389	2/23/37	3,150	1913	1,370
2. Mill Creek	Near Pray	148	1	2,300	6/6/52	3.9	11/9/52	112	1952	72.0
3. Yellowstone River	Near Livingston	3,551	1	30,600	6/20/43	590	1/22/40	3,223	1956	2,075
4. Shields River	Near Wilsall	87.8	1	1,770	6/4/58	Not Determined		65.5	1953	33.8
5. Shields River	At Clyde Park	543	1	4,550	6/5/48	1.8	8/29/35	180	1952	68.6
6. Brackett Creek	Near Clyde Park	57.9	1	1,400	5/22/48	0.5	12/23/52	38.7	1948	6.9

Source: U. S. Geological Survey Water Supply Papers and "Surface Water Records of Montana"

Note: 1. Some irrigation diversions occur above this station

valleys below.

The use of surface water is widespread for domestic, agricultural, and recreational purposes. The town of Gardiner uses surface water from the Yellowstone River as a portion of its municipal supply. (See Table 7 for a chemical analysis of this water supply.) The 1964 Census of Agriculture indicates that over 57,000 acres were being irrigated in Park County at that time. As is the case in most counties in Montana, a potential exists for the irrigation of even more acreage. A final but important use of surface water is for recreational purposes. The mountain lakes and streams in the county are ideal habitat for fish and waterfowl and draw many fishermen and hunters to the area each year.

TABLE 7

Chemical Analysis of Municipal Water Supplies
(All Figures in Milligrams per Liter)*

City or Town	Clyde Park	Cooke City	Cooke City	Gardiner	Silver Gate	Wilsall
Source	Spring	Hoosier Spring	Soda Butte Spring	Yellowstone River	Spring	Well
Date	6/69	8/66	12/67	5/66	6/69	6/69
Total Solids	320	140	154	142	94	450
Hardness	150	121	105	72	100	310
Ca	14	29	34	16	24	88
Mg	9	12	5	9	10	23
Na+K	120	26	29	23	7	44
Co ₃	0	9	0	0	0	0
HCO ₃	314	168	183	98	122	245
SO ₄	47	17	13	26	10	126
Cl	12	4	4	13	4	49
NO ₃	8.4	0.0	0.0	0.0	0.4	6.2
F	0.92	0.0	0.0	0.7	0.14	0.48
Fe	0.0	0.00	0.47	0.6	0.0	0.0
As	-	0.00	0.00	-	-	-
Pb	-	0.00	0.00	-	-	-
Cu	0.07	0.00	0.00	-	0.3	0.00
Zn	0.03	-	0.00	-	0.02	0.03

* See Appendix I, Table A, for accepted water quality standards
Source: State Department of Health, Helena, Montana

Water Use Classification

The Water Pollution Control Council has classified the streams and drainages in Montana according to the water use classification definitions shown in Appendix I. The streams and drainages of Park County and surrounding areas are classified as follows:

Yellowstone River drainage from the	B-D ₁
Yellowstone Park boundary to the Laurel	
water supply intake	

Ground-Water Resources

Ground water from wells and springs is widely used by residents of Park County for stock and domestic purposes. The communities of Clyde Park, Cooke City, Gardiner, Silver Gate, and Wilsall have appropriated ground water for municipal use. (See Table 7 for chemical analyses of these water supplies.) Private wells and springs supply water to many residents of other communities in the county. As of January 1970, 569 well and 746 spring appropriations were on file for Park County with the Montana Bureau of Mines and Geology. A total of 280 wells are reportedly used for domestic purposes, fifty five for livestock, 168 for a combination domestic and stock, nineteen for irrigation, and forty seven for a variety of other purposes. There are reported to be 428 springs used for livestock, forty six for domestic use, eighty for irrigation, 102 for a combination domestic and stock use, and seven for commercial purposes; the use of seventy three springs is not reported. Most of the ground-water appropriations are along the Shields and Yellowstone Rivers.

There are a number of geological reports that describe geological conditions in parts of Park County. The most informative of these is Iddings, J. P., and Weed, W. H., 1894, Livingston Folio, Montana: U. S. G. S. Atlas Livingston 1.

Montana Bureau of Mines and Geology Spec. Pub. 26, "Reconnaissance ground-water studies in northern Park County, Montana," 1962, by S. L. Groff, is the only technical ground-water report available for the county.

The occurrence, availability, and quality of ground water in Park County is dependent on geological conditions. The county contains a wide variety of rocks of many different geological ages which reflect the complex geological history.

The geological history of Park County includes long periods of sedimentation punctuated by periods of uplift and volcanism.

Faulting, folding, and uplift were dominant forces forming the Beartooth Plateau in southern Park County. Glaciation occurred in the high mountains of the county.

The geological units of significance to the water resources of Park County are (1) sedimentary bedrock formations of Paleozoic (230 to 600 million years old) and Mesozoic (65 to 230 million years old) age, (2) igneous and metamorphic rocks of Precambrian (over 600 million years old) and Tertiary (one to seventy million years old) age, and (3) alluvium and sedimentary rocks of Tertiary and Quaternary age (less than one million years old).

Precambrian metamorphic rocks (mainly gneiss and schist) are present over large areas in the Absaroka Range. Large exposures of volcanic rocks, including andesite, dacite, and basalt, are present in the east side of the Gallatin Range and the southwest end of the Absaroka Range. Intrusive igneous rocks are present in the Crazy Mountains and in the southwest end of the Absaroka Range. Igneous and metamorphic rocks generally have low porosities and permeabilities (ability to store and transmit water). Generally, they will yield little or no water to wells, but fractures and fault zones can yield good quality water in sufficient amounts for stock and domestic purposes. Ground water in areas underlain by igneous and metamorphic rocks has undergone little development due to their poor water yielding ability and the mountainous terrain associated with their exposures. These rocks are the source of numerous small springs.

Sedimentary rocks of Paleozoic and Mesozoic age are exposed in scattered areas in the Absaroka Range, near Gardiner, and in a broad east west strip south of Livingston. North of Livingston the Livingston Formation (of both Mesozoic and Tertiary age) covers almost the entire northern part of Park County. The Livingston Formation is many thousands of feet thick and consists of both igneous and sedimentary rocks. Sandstone, conglomerate, and shale are prominent rock types in the Livingston Formation. This formation is generally capable of yielding small amounts of water for stock and domestic use. A number of wells in northern Park County are drilled into the Livingston and numerous springs originate in this formation.

There is a wide variety of rock types present in the Paleozoic and Mesozoic deposits, including shale, quartzite, conglomerate, limestone, sandstone, siltstone, and dolomite. Generally, these rocks are present in mountainous terrain and have not been drilled to determine their water yielding potential. Many of these sedimentary formations, such as the Mission Canyon Limestone, Flathead Quartzite, and Eagle Sandstone, contain ground water and furnish water to springs.

Sedimentary rocks of Tertiary age in Park County are the Fort Union Formation and a thick section of unnamed sediments. The upper portion of the previously discussed Livingston Formation is also Tertiary in age. The distribution and thickness of Fort Union in the county is poorly known. Fort Union sediments have been mapped north and west of Livingston. These sediments may yield some water from sandy zones. A thick sequence of semiconsolidated to unconsolidated sediments are present in the Yellowstone Valley. Where exposed, these sediments are composed of silt, clay, and volcanic ash. Tertiary sediments are thought to underlie younger deposits in much of the upper Yellowstone Valley. Few if any wells have been drilled into Tertiary deposits, and the water yielding potential is unknown but is probably poor.

Alpine glaciation occurred in the Absaroka and Gallatin Ranges during the Pleistocene Epoch (twenty thousand to one million years ago). Morainal deposits were left in high mountain valleys and in the Yellowstone Valley. These deposits consist of compacted mixtures of boulders, gravel, sand, silt, and clay. Outwash deposits of sand and gravel commonly will yield small to moderate quantities of ground water to wells, but most of the glacial deposits will yield very little water to wells.

Alluvium of Pleistocene and Recent ages is present along the major streams in the county. The Shields River drainage contains considerably less alluvium than the Yellowstone River drainage. Flathead Creek and the Shields River below Meadow Creek and in the vicinity of Clyde Park contain alluvial deposits that range in thickness from a few feet to over fifty feet. Yields from this alluvium are usually small to moderate, but as much as six hundred gpm can be pumped from alluvium near Clyde Park. The Yellowstone River valley contains flood plain deposits and numerous alluvial terraces. These deposits consist of unconsolidated mixtures of boulders, sand, gravel, silt, and clay and are commonly forty to seventy five feet thick. The alluvium will yield small to large amounts of good quality water to wells. In the area south of Livingston there are a large number of wells drilled into alluvial flood plain deposits along the Yellowstone River. Ground water in the alluvium is recharged by infiltration of stream and irrigation water.

The ground-water resources of Park County have not been investigated in detail. Quaternary alluvium along the major streams, particularly the Yellowstone River, is widely used as a source of ground water and is capable of considerable additional development. There will be continued development of ground water for stock and domestic purposes and to a lesser extent for irrigation, industrial, and municipal purposes. The ground-water resources of Park County will require additional hydrogeological study to aid in proper development of this

valuable resource.

- Sources:
1. M. K. Botz, Montana Bureau of Mines and Geology, Butte, Montana, 1970
 2. State Department of Health, Helena, Montana
 3. U. S. G. S. Water Supply Papers and "Surface Water Records of Montana"
 4. Weather Bureau, Climatological Data, Montana Section, 1969

THE SOILS

General

General descriptions of soils in specific areas are useful in predicting the potential problems which might be encountered during private and public works construction. Park County has an interesting and complicated geologic history which has greatly influenced the soil structure of the area. The dominating physiographic features are the broad stream valleys bordered by high mountain ranges.

As a result of some isolated mountain glaciation in Park County, some areas are covered by glacial outwash and deposits including till. Till is generally defined as nonsorted and nonstratified sediment carried or deposited by a glacier. Also, extensive drainage throughout the area over periods of time has resulted in erosion of the mountainous terrain and the subsequent filling of the stream valleys and drainage basins with alluvial material. The soils of Park County are made up of the alterations of the till, alluvium, and other geologic parent materials of the nearby mountains due to conditions of climate, topography, and living organisms.

Soil Map

The Soil Conservation Service of the United States Department of Agriculture currently has a program under way to produce general maps for each county in Montana. At the present time the detailed soil study of Park County has progressed to the point where a preliminary general soil map has been prepared. The map is presented in this report as Map 4. In developing this map, the Soil Conservation Service made field studies and observations which resulted in the designation of fourteen general soil areas. Each general soil area,

as a rule, contains a few major and several minor soils. Soils within an area may differ greatly in short distances, and any one soil may occur in more than one area. Thus, the general soil map does not show the kind of soil at any particular point but shows specific patterns of soils.

The Soil Conservation Service is continuing to expand the detailed soil study of Park County. When this study is complete, a final general soil map will be available from the local office in Livingston. Detailed information for specific areas may also be obtained from this office. It is recommended that all of the available information be consulted during the planning of proposed public works projects in Park County. Also, on site soil investigations should be performed.

The Soil Conservation Service preliminary draft descriptions of the fourteen general soil areas shown on the soil map are presented as follows:

3-1. These are terrace soils developed in outwash materials from the adjacent mountains, chiefly the Crazy Mountains. They are dominantly deep, dark brown, silty soils which exhibit medial to maximum soil development. Significant inclusions in these soil areas are deep to moderately deep clay loam soils developed in clay shales, gravelly terrace edges, and shallow gravelly soils.

3-2. Big Timber-Castner Soils. This area and area 3-3 are similar geologically and the primary soils are the same; however, this area has more large smooth landscapes which are being cropped or have cropland potentials. These smooth areas are silty to clayey, ranging in depth from twenty to fifty inches over sandstone or shale.

3-3. Big Timber-Castner Soils. These soils are similar to the ones in area 3-2 except for significant inclusions of Midway and Rockland soil series.

3-5. Castner-Midway-Rockland Soils. These are areas of soils dominated by the combined characteristics of the individual soil series.

3-6. Prospect Soils. These soils consist of glacial till and outwash deposits or glacial dumps.

4-1. These are clay to heavy clay soils developed in alluvium, loess, and residuum. Some degree of salinity and alkalinity are associated with these soils. This area has some Big Timber and Castner Series soils interspersed within it.

5-1. The soils of this area are similar to the soils of area 3-1 except they are of the Chernozem soil group rather than the Chestnut group. They are on the highest terraces just at the base of the Crazy Mountains. These soil areas also have significant inclusions similar to the soils of area 3-1.

7-1. These are alluvial soils which have associated zonal soils of the low stream terraces.

7-2. These are moderately deep to deep dark brown, thin solum, silty soils developed in mantle washed from the Absaroka Mountains. These soil areas include soils to the Big Elk Series and associated cobbly gravelly soil types.

8-1. Rockland-Basic-Intermediate Igneous. These areas are mostly timbered and consist of volcanic rock covered with a soil mantle.

8-2. Merino-Rockland Soils. This combination of soil series also includes soils of the Blaine, Big Timber, and Castner Series.

8-3. These soil areas consist of timbered mountains covered with a chiefly volcanic soil mantle.

8-4. Rockland. These are areas of barren rockland.

8-5. These areas are similar to 8-1 except that they are located in a lower precipitation belt and the areas are characterized by grass rather than timber.

Conclusions

The soils of Park County have generally been easy to deal with where domestic water wells and individual sewage drainfields have been constructed. The alluvium and other surface soil deposits have been found to be extremely variable in permeability, however. This has an effect on both the quantity of water available in shallow domestic wells and the successful operation of individual sewage drainfields.

Construction of municipal water and sewer systems in the various soils of Park County has not been difficult. Pipeline trench digging in the sands and clays is extremely easy while the coarse gravels slow operations somewhat. Bedrock at shallow depths is not common in the valley bottoms; however, it can be expected at normal water and sewer line installation depths at or near the toe of mountain slopes. Detailed soil information should be obtained before project planning and construction cost estimating are begun. The services of the soil

scientists of the Soil Conservation Service should be utilized for the explanation of the specific characteristics of each soil series named in the preceding general soil map descriptions. Also, the soil scientists can provide interpretations of the individual soil characteristics which are pertinent to the construction of private and public work projects.

Source: U. S. Department of Agriculture, Soil Conservation Service, Livingston, Montana

COMMUNITY WATER SYSTEM FACILITIES

General

This comprehensive report covers the overall problems, existing or projected, for Park County, Montana. The volume of data processed and evaluated and the intent of the report allow only a general analysis of any one system.

The intent of this report is to point out the general needs of each community with the objective that each community may in the future be provided with a safe and adequate water system. The general solutions to overall problems suggested in this report may have to be modified when detailed studies are made. These modifications may be in exact size of parts of a system or in some detailed design variation but will not detract from the overall value of the general information presented.

Basically, the demand for water from community systems is for domestic, fire fighting, and industrial uses. The demand for industrial water supply in small communities has not been extensive in Montana and in most cases will not control the design of community systems. Sufficient water for fire fighting must be considered; however, economic feasibility will usually control the extent of such facilities. In most small communities a system with sufficient capacity to give high ratings for fire protection would require facilities considerably larger than necessary for domestic purposes. The community might be unable to finance such an improvement; the approach, therefore, has been to propose a system suitable for present domestic needs. These basic facilities can be expanded for more complete service and for higher fire ratings as it becomes economically feasible.

The domestic use of water has increased greatly in recent years. This is partially due to improved economic conditions which make it possible for families to acquire such water consuming appliances as

dishwashers, waste disposal units, and automatic washing machines. Water use for beautifying property has also increased. The most essential condition is adequate, safe, and potable water for domestic purposes, and this has been the primary consideration in this study. Appendix II contains further information on analysis criteria.

Basic Considerations

Communities studied in this comprehensive plan were those with a minimum of five potential users and a maximum population of 5,500. Each community within this category was visited at least once. During these visits the type of water facilities available was examined, and an evaluation of the facilities was made from the standpoint of fulfilling the needs of the residents.

The existing systems were found to be quite varied in their operation, condition, and suitability for serving the needs of the users. The situation in each community was evaluated separately; however, some general classification of the various systems was possible. These are described briefly in the following paragraphs so that the general philosophy of the analysis can be shown.

1. In some communities the homes are quite widespread and few in number. Good water in adequate quantities can be found at reasonable depths, and for such situations private wells will provide a safe and suitable water system.

2. Many communities have had access to good water from private wells for many years. In some of these communities population is increasing, and the area is becoming more densely settled. As a result, tests for bacteriological quality of well water occasionally indicate that pollution is present. When this occurs, it is usually the beginning of a problem which will continue to worsen. Increasing population and a higher potential for contamination indicate the need for a safe community water facility. The system should be one which will serve the domestic needs of the present residents with provisions for improvements and expansion as needed.

3. Many communities have enjoyed a central water system for years but have not made annual improvements and replacements. This has resulted in overloaded and antiquated systems. Suggestions for immediate improvements which will fit into an overall replacement program are included in this report.

4. Some communities which have experienced a steady population growth are finding that their water systems are inadequate for present demands and will require enlargement. Population projections

and economic trends are used to determine the need for improvements and also to justify the type and extent of proposed improvements.

Park County

The estimated 1970 population of Park County is eleven thousand. Approximately nine thousand, or eighty two percent of these people, are presently served by central water systems, and the remainder are served by such facilities as wells and springs. By 1980 about nine thousand people will still have access to central water systems because the population will remain essentially steady, and it is not feasible to propose new water systems. It is expected that the remaining eighteen percent will live in outlying areas, and the homes will not be close enough together to make central systems feasible.

Gardiner

Existing System. The estimated 1970 population is seven hundred. Population projections indicate that the community will show decreased population throughout the planning period. The community is served by a central water system, and the layout is shown on Map 5.

Water supply is presently obtained from the Yellowstone River. The pumping capacity for this source is 350 gallons per minute (gpm). Additional water supply is obtained from two springs located to the north of the community. These springs have a capacity of two hundred gpm. The combined capacity of these two sources, 550 gpm, is adequate for the present and future needs of the community. An excellent quality water is available from these sources. Storage presently consists of two storage tanks located on hills to the north of the community. The combined capacity is 336,000 gallons which is very adequate for the present and future populations. The distribution system consists of new water mains, four, six, and eight inches in diameter. This provides adequate flows and pressures throughout the system.

Improvements Next Five to Ten Years. For 1975 the population is expected to be 690. Minor repair and replacement will be necessary during this period.

Improvements by 1990. For 1990 the population is expected to be 650. The present system will be adequate for the needs of the community throughout the entire planning period. Only minor repair and replacement will be necessary to keep this system in satisfactory operating condition.

Wilsall

Existing System. The 1970 population is estimated to be 250. A community water system is presently in existence, and the layout is shown on Map 6.

Water supply is obtained from two wells with a combined capacity of 110 gpm. This is an adequate amount of water for the present and future needs of the residents. The distribution system consists of four, six, and eight inch water mains which provides adequate flows and pressures throughout the system. Storage presently consists of a 100,000 gallon storage tank which is adequate.

Improvements by 1990. For 1990 the population is expected to be 230. The existing water system will be adequate for the needs throughout the entire planning period. Only minor repair and replacement will be necessary to keep the facility in satisfactory operating condition.

Clyde Park

Existing System. The estimated 1970 population is 225. A community water system facility presently exists, and the system layout is shown on Map 7.

Water supply is obtained from springs located two miles north of the community. These springs have a capacity of one hundred gpm. This is not adequate for the present population, and water shortage is experienced during the high demand periods of the summer. A six inch supply line carries water from this source to a 175,000 gallon concrete storage reservoir located just north of the community. This is adequate storage for the needs throughout the entire planning period. An eight inch supply line continues on to the distribution system. This supply line has adequate capacity for present demands. The distribution system consists of four and six inch water main. The distribution system has adequate capacity for the needs.

Improvements Next Five to Ten Years. For 1975 the population is expected to be 215. Additional water supply should be developed during this period. A well with a capacity of fifty gpm could be developed in the location shown on Map 7. This additional water supply is needed to alleviate the present water shortage experienced during the summer months. This would result in an adequate quantity of water being available for the entire planning period. Replacement of certain sections of the distribution system will also be necessary. Some leakage has been apparent, and this will continue to be a maintenance problem

Improvements by 1990. For 1990 the population is expected to decline to 170. The existing system together with the improvements proposed under the five to ten year plan will provide a facility which is adequate for the needs. Minor repair and replacement will continue to be necessary throughout the entire planning period.

Cooke City

Existing System. The permanent population is estimated to be forty for 1970. During the summer months many tourists stop here, and the transient population is a great deal higher. A community water system is presently in existence as shown on Map 8.

Water supply is obtained from a group of springs. The exact yield of these springs is not known; however, it is reportedly adequate for the needs. Storage facilities consist of a fifteen thousand gallon storage tank located on high ground to the north of the community. This facility also has adequate capacity. The distribution system consists of three, four, and six inch water mains. This distribution system is new and is constructed of asbestos cement pipe. Adequate flows and pressures are available throughout the distribution system.

Improvements by 1990. The population is expected to remain essentially steady throughout the planning period. The existing water system will be adequate for the needs throughout the entire planning period. It may be necessary to develop additional water supply if tourism increases. This could be accomplished by developing additional springs or wells which are readily obtainable in the area.

Silver Gate

Existing System. The 1970 population is estimated to be fifty. The community experiences a high influx of tourists during the summer months. The transient population is many times that of the permanent residents. A community water system is presently in existence, and the layout is shown on Map 9.

Water supply is obtained from a spring located to the north of the community. The capacity of this spring is not known; however, it is reportedly adequate for the needs. A two inch supply line continues from the spring site to a sixteen thousand gallon storage tank. This storage facility has adequate capacity for the needs. A four inch supply line continues on to the distribution system. Most of the distribution system itself is one and one half inch diameter water

pipe and provides adequate flows and pressures to each user.

Improvements Next Five to Ten Years. The population is expected to remain essentially steady throughout the planning period. There is a considerable portion of the community which does not presently have access to the community water system. It is proposed that the system be extended to provide service to this area as shown on Map 9. It may be necessary to develop a well with a capacity of fifty gpm to supply the additional demand. If tourism continues to increase, it may be necessary to develop additional water supply. This can be readily accomplished in the area by constructing additional wells.

Improvements by 1990. Minor repair and replacement will be necessary throughout the entire planning period. The need for additional water supply may also develop. This can be readily obtained as previously mentioned.

Pine Creek

Existing System. The forty persons who presently reside in this community rely on private wells and developed springs for water supply, and an adequate quantity of good quality water is available to each user. These wells are about 150 in depth. These systems do provide suitable water supplies for each residence.

Improvements by 1990. For 1990 the population is expected to be thirty five. The present use of these private systems will continue to be the most suitable means for obtaining water supply throughout the entire planning period.

Springdale

Existing System. The estimated 1970 population is thirty three. This population presently relies on private wells for water supply. These wells provide an adequate quantity of good quality water for each household. The wells range in depth from thirty five to fifty feet and do not present operational problems. These private systems do provide a suitable water supply for the community.

Improvements by 1990. For 1990 the population is expected to be twenty. The present use of private wells will continue to be the most suitable means for obtaining water supply throughout the entire planning period.

Jardine

Existing System. The thirty persons who presently reside in this community rely on private wells and developed springs for water supply. These systems provide an adequate quantity of good quality water for each household. The wells are about one hundred feet in depth so that operational problems are minor.

Improvements by 1990. For 1990 the population is expected to be twenty. The present use of private wells does provide a suitable water supply for each household. These systems will continue to be the most feasible means for obtaining water supply.

Emigrant

Existing System. The twenty persons who presently reside in this community use private wells for water supply. These wells range from forty to sixty feet in depth and do not present operational problems. A good quality water is available from these wells in adequate quantities for the needs.

Improvements by 1990. For 1990 the population is expected to decline to fifteen. The present use of private wells will continue to be suitable throughout the entire planning period.

COMMUNITY SEWER SYSTEM FACILITIES

General

Each use of water adds some material or alters some characteristic enough to change the original quality of the water and often to pollute it. The transportation and dilution of municipal, industrial, and agricultural wastes are important and necessary uses of water; therefore, special emphasis is placed on the control of water pollution from these sources. Some of these wastes can be carried in limited amounts without damage to the resource. Some wastes if discharged into water courses can make their way into underground aquifers and pollute the ground water so that it is unsuitable for further use.

Pollution by definition and interpretation is a matter of degree. Since it is inevitable that the quality of water will be altered with each use, it is of critical importance to control the degree of pollution.

It is public policy, established by the state legislature, to maintain reasonable standards of purity for the water of the state. These standards are to be consistent with the use of these waters, including their use in carrying away the water borne waste products of society. The current Federal Water Pollution Control Act in reference to pollution abatement gives the individual states discretion in assessing the physical and economic feasibility of complying with water quality standards. The "Water Quality Criteria," "Water Use Classifications," and "Policy Statements" of the Montana Water Pollution Control Council for streams and rivers in Montana have been included in Appendix I.

Sewage may be broadly categorized as domestic or municipal waste, industrial waste, and animal or agricultural waste. Animal wastes are usually not involved in community sewage facilities; however, they do constitute a potential source of pollution which must be controlled and prevented from entering streams or other potential water supplies.

Although industrial activity throughout Montana has been limited, the need for control and treatment of industrial wastes is apparent. Industrial wastes vary in quantity and composition as greatly as the products and processes which generate them. They include toxic chemicals, solids carried in suspension, brines, strong acids and alkalies, oils, dyes, floating solids, and the heat generated by industrial processes. Industrial wastes are not found to be a major factor in the design of most community sewage facilities. Where economic projections indicate industrial development, the relationship to loading on domestic sewer systems is considered.

Domestic sewage is the primary consideration of this study and has been the basis for design and analysis. Where particular systems are subjected to loading from industrial sources, a more detailed study will be necessary. The general approaches outlined in "Analysis Criteria" in Appendix III will suffice in practically all cases.

Basic Considerations

There are generally three main methods of sewage disposal. These are septic tanks, mechanical sewage treatment plants, and wastewater stabilization ponds. Local soil conditions, availability of land, and density of population are the basic factors which govern the selection of a particular method.

Many of the smaller communities have relied on individual septic tanks and cesspools for each home to handle sewage disposal. Septic tanks are suitable if the population density is low and if the systems are

properly designed and maintained. Overflow from these tanks must drain into the soil and, depending on local soil conditions, may or may not create a problem. There is a limit to the amount of water that even loose granular soil can absorb. Density of population and the length of time the effluent has been entering the soil are factors which indicate whether septic tanks can be suitable for sewage disposal.

When economically feasible, community sewage collection and disposal systems are much more desirable than individual systems. Community systems eliminate the worry of septic tank failure, the danger of well contamination, and the problem of soil saturation. However, it is usually uneconomical to serve a few homes scattered over a large area with a community sewer system.

The type of sewage disposal facilities to be used can generally be determined on the basis of economic factors. Mechanical treatment plants provide an excellent means of sewage disposal although the initial cost, maintenance cost, and power cost are usually high. Wastewater stabilization ponds are an ideal method of sewage disposal and usually are the most economical to construct and maintain.

The Montana Water Pollution Control Council has established the criteria that treatment of domestic and industrial wastes shall be secondary treatment or its equivalent. For domestic sewage, mechanical treatment plants or stabilization ponds, when either is properly designed, constructed, and operated, meet these requirements.

A schedule for completion of secondary treatment facilities by communities across the state has been established by the State Department of Health. The target date is included for individual towns when applicable.

Park County

Approximately 8,500 people, or seventy seven percent of the Park County population, are presently served by community sewage facilities. By 1990 about 9,280, or eighty four percent of the population, will have access to community facilities if the proposed expansion program is followed. The remaining sixteen percent will live in outlying areas, and the homes will not be close enough together to make community systems feasible.

Gardiner

Existing System. The present population is estimated to be seven

hundred. A community sewer system is in existence which serves a portion of this population. The system layout is shown on Map 14.

This existing system is only a partial one and does not have an adequate sewage treatment facility. There is a substantial increase in population during the summer months, and this additional population was considered in making system proposals. The residents which do not have access to the existing system rely on private septic tanks and cesspools for sewage disposal. Also, many homes discharge sewage directly into the river. A community sewer system facility is feasible and necessary for this community. The existing collection system is old and badly deteriorated. It will be necessary to completely replace this existing system with new pipe.

Improvements Next Five to Ten Years. For 1975 the population is expected to be 690. As previously mentioned, a substantial population increase is experienced during the summer months. Capacity to serve this additional population is provided for in the proposed system.

A collection system consisting of eight inch pipe will pick up sewage from the area located on each side of the river and carry it to a collection point. There are two wastewater stabilization pond sites available for use. The proposed site is located on the north side of the river a considerable distance northeast of the community. The size of this proposed wastewater stabilization pond is ten acres in order that the additional summer population can be served. This pond site is the most desirable since only one lift station would be necessary for system operation. At the collection point a lift station will be necessary to force sewage across the river to a ten inch outfall line. The collection system from the north side of the river will discharge into this ten inch outfall line entirely by gravity. Sewage will then continue on through the outfall line to the treatment facilities entirely by gravity.

There is an alternate pond site located on the south side of the river northeast of the community. For this pond site, a lift station will be necessary on the south side of the river to transmit the sewage from this area to the alternate pond site. The collection system on the north side of the river would discharge into a lift station and be pumped across the river to the second lift station. All of the sewage would then be forced through a six inch force main to the alternate pond site. The alternate arrangement is less desirable because a second lift station is required and the operational costs would be increased.

Improvements by 1990. For 1990 the population is expected to be 650. The increase in population experienced during the summer months will

continue throughout the planning period. The system as proposed under the five to ten year plan will adequately serve the community throughout the entire planning period. Major repairs and expansion of the sewer system will not be necessary. Minor repair and replacement will be necessary to keep the system in satisfactory operating condition.

Wilsall

Existing System. The 250 persons who presently reside in this community rely on private septic tanks for sewage disposal. The soil is a sandy loam material which does not cause operational problems. The existing systems reportedly operate satisfactorily; however, there is sufficient population to justify the construction of a community system.

Improvements Next Five to Ten Years. By 1975 the population is expected to be 250. A community sewer system is feasible for this population, and it is proposed that it be constructed during this period. A collection system consisting of eight inch sewer main will have sufficient capacity for the needs throughout the planning period. The community can be served entirely by a gravity system. An eight inch outfall line will extend to the east of the community where a wastewater stabilization pond can be constructed. Sufficient land is available for a 2.5 acre pond. The facility as proposed will have adequate capacity for the needs throughout the entire planning period.

Improvements by 1990. For 1990 the population is expected to decline to 230. The system as proposed under the five to ten year plan will provide adequate sewage disposal. Minor repair and replacement will be the only improvements necessary.

Clyde Park

Existing System. At the present time 225 persons reside in this community. Sewage disposal is handled by private septic tanks. The soil is sandy and gravelly with a high water table during the irrigation season. This causes operational problems, since drainfields do not function properly. The community has considered constructing central sewer system facilities, and it is feasible for them to do so.

Improvements Next Five to Ten Years. For 1975 the population is expected to be 215. It is proposed that a community sewer system be constructed during this period. A collection system consisting of eight inch pipe would pick up sewage from throughout the community

to a collection point near the southwest edge of the community. From this point an eight inch outfall line would continue on to the treatment facility entirely by gravity. Sewage treatment could be handled by a 2.5 acre wastewater stabilization pond. The sewer as proposed would provide central sewage facilities to each resident of the community.

Improvements by 1990. The population is expected to decline to 170 by 1990. A portion of this decrease is believed to be due to the present problems associated with private sewer systems. The community system as proposed under the five to ten year plan would be adequate for the needs throughout the entire planning period. Minor repair and replacement would be the only improvements necessary to keep the system in satisfactory operating condition.

Cooke City

Existing System. The permanent population is estimated to be forty. There is a substantial population increase during the summer months. Many restaurants, motels, and other tourist attractions exist in the community. These large water users experience many operational problems with the present sewage disposal facilities. At the present time sewage disposal is handled by private septic tanks. The soil is primarily sand and gravel; however, many clay deposits are dispersed throughout the area. These private systems can not handle the high sewage flows experienced during the summer months.

Improvements Next Five to Ten Years. Through 1975 the permanent population and the increase during the summer months will remain essentially steady. Improved sewage disposal facilities are needed in this community. The proposed sewage collection and disposal system is shown on Map 17.

A collection system consisting of eight inch pipe will collect sewage from the entire community to a point near the west edge of the community. A lift station will then be necessary to force the sewage on to the treatment facility. A three acre wastewater stabilization pond would provide adequate sewage treatment. It may not be possible to find sufficient land area for this pond; therefore, an alternate mechanical treatment plant is also proposed. A detailed cost comparison would be necessary to determine which type of sewage treatment is most feasible.

Improvements by 1990. For 1990 the permanent population and the increase experienced during the summer months will remain essentially the same as the present. The system as proposed under the five to ten year plan will adequately serve the needs of the community

throughout the entire planning period. Minor repair and replacement are the only improvements which are anticipated.

Silver Gate

Existing System. The permanent population for 1970 is fifty. A substantial population increase is experienced during the summer months due to tourism. Sewage disposal is presently handled by private septic tanks. The soil is primarily sand and gravel so that these facilities generally operate satisfactorily. The large water users, such as motels and restaurants, do experience many operational problems during the summer months. A community sewer system facility is feasible for this community.

Improvements Next Five to Ten Years. The present permanent population as well as the increase due to tourism are expected to remain essentially steady throughout the planning period. A community sewer system is proposed, and the layout is shown on Map 18.

A collection system of eight inch sewer pipe will pick up sewage throughout the community to a collection point near the west edge of the community. One lift station will be required on each side of the creek to force sewage on to the treatment facilities. A wastewater stabilization pond with a surface area of three acres would provide adequate sewage disposal. It may be difficult to obtain sufficient land area for this pond, and therefore, an alternate mechanical treatment plant is proposed. A detailed cost comparison will be necessary to determine the most feasible method for sewage disposal.

Improvements by 1990. The system as proposed under the five to ten year plan will provide adequate sewage disposal. Minor repair and replacement are the only improvements which will be necessary throughout the planning period.

Pine Creek

Existing System. The forty persons who presently reside in this community rely on private septic tanks for sewage disposal. The soil is primarily a gravelly material which readily accepts sewage effluent. There are no major operational problems experienced with these private systems.

Improvements by 1990. The population is expected to remain essentially steady throughout the planning period. The present use of private septic tanks does provide adequate sewage treatment. These

private systems will continue to be a suitable means of sewage disposal throughout the entire planning period.

Springdale

Existing System. The present population is estimated to be thirty three. The population is expected to decline throughout the planning period. The residents presently rely on private septic tanks for sewage disposal. The soil in the area is a gravelly material which readily accepts sewage effluent. Major operational problems do not exist with the operation of these private facilities.

Improvements by 1990. For 1990 the population will have declined to twenty. The present use of private septic tanks does provide adequate sewage treatment. These private facilities will continue to be the most suitable method of sewage disposal throughout the entire planning period.

Jardine

Existing System. The present population is estimated to be thirty. Population projections indicate that the community will decline in population throughout the planning period. Presently the residents rely on private septic tanks for sewage disposal. These facilities operate satisfactorily since the soil in the area is a gravel material. Excellent drainage characteristics exist so that septic tank effluent drains away readily. These private systems do result in satisfactory sewage disposal for the residents of the community.

Improvements by 1990. For 1990 the population is expected to be twenty. The present use of private septic tanks will continue to be the most suitable method of sewage disposal.

Emigrant

Existing System. The twenty persons who presently reside in this community use private septic tanks for sewage disposal. The community is underlain by gravel which readily accepts effluent from the private septic tanks. Operational problems do not exist because of the good drainage properties of the soil. These private systems are a suitable means for handling sewage disposal.

Improvements by 1990. For 1990 the population is expected to decline to fifteen. The present use of private septic tanks will continue to be the most suitable method for handling sewage disposal.

PREFACE TO MAPS

The following maps have been prepared from several sources. The county maps were prepared from Transverse Mercator Projection Series Maps and Montana Highway Department Maps, Planning and Survey Series. The reduction of the county maps necessary for this publication makes them useful for general reference purposes only.

The town and community base maps used herein are taken from Montana State Highway Commission City and Town Plats prepared from aerial photographs dated 1961 to 1969 and have been updated where necessary. On-site surveys, plats obtained from individual towns, and aerial photography conducted in 1970 were also used. Uncontrolled mosaics have been used and scales are, accordingly, only approximate and are shown for referencing purposes only. The mapping operation was supplemented by field checks made during 1970.

Land use information was obtained by field surveys, supplemented and checked by aerial photography during 1969 and 1970.

Water and sewer systems maps show existing facilities for individual towns and communities except where the information was not available. Data concerning these community facilities was obtained from the records of the individual communities and of the State Department of Health. Water and sewer lines are shown in the center of streets to indicate the existence of lines rather than precise locations. The sizes of lines, obtained from the most current information available, are indicated when possible. The locations of recommended improvements are given as relative locations and are not meant to be scaled from the individual town or community maps.

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MAP I

COUNTY MAP
GENERAL RELIEF

LEGEND

● CITIES-TOWNS

○ COUNTY SEAT

ROADS-HIGHWAYS
 STATE HIGHWAY U. S. HIGHWAY

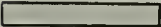
 RAILROADS

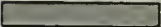
 STREAMS-LAKES

 COUNTY BOUNDARY

 INDIAN RESERVATION

 0-3,000 FT. ELEVATION

 3-5,000 FT. ELEVATION

 5-7,000 FT. ELEVATION

 OVER 7,000 FT. ELEVATION

MAP 2

LEGEND

MAJOR STATE-WIDE COVERAGE

POWER AND GAS SYSTEMS

-  POWER PLANT (IN MEGAWATTS)
-  1 to 50 KILOVOLTS
-  51 to 100 KILOVOLTS
-  101+ KILOVOLTS
-  PROPOSED LINES
-  GAS LINES

RECREATION AREAS

1. LOST CREEK STATE PARK
 2. LEWIS AND CLARK CAVERNS STATE PARK
 3. LAKE MARY RONAN STATE PARK
 4. MEDICINE ROCKS STATE PARK
 5. ROSEBUD STATE PARK
 6. ROCK CREEK STATE PARK
 7. MAKOSHIKA STATE PARK
 8. WEST SHORE STATE PARK
 9. WOODS BAY STATE PARK
 10. BITTERROOT LAKE STATE PARK
 11. ASHLEY LAKE STATE PARK
 12. LONE PINE STATE PARK
 13. JAMES KIPP STATE PARK
 14. HOOPER MEMORIAL STATE PARK
 15. HELL CREEK STATE PARK
 16. FINLEY POINT STATE PARK
 17. ELMO STATE PARK
 18. FLATHEAD LAKE STATE PARK
 19. YELLOW BAY STATE PARK
 20. WALSTAD MEMORIAL PARK
 21. THOMPSON FALLS STATE PARK
 22. WHITEFISH LAKE STATE PARK
 23. WAYFARERS RECREATION AREA
 24. TIBER RESERVOIR RECREATION AREA
 25. CLARK CANYON RESERVOIR RECREATION AREA
 26. ENNIS RECREATION AREA
 27. DEADMAN'S BASIN RESERVOIR RECREATION AREA
 28. PAINTED ROCKS RESERVOIR RECREATION AREA
 29. CANYON FERRY RECREATION AREA
 30. LOGAN PARK RECREATION AREA
 31. NELSON RESERVOIR RECREATION AREA
 32. BEAVERTAIL HILL RECREATION AREA
 33. GLACIER NATIONAL PARK
 34. YELLOWSTONE NATIONAL PARK
-  NATIONAL FORESTS

MAP 3

COUNTY MAP LAND OWNERSHIP

LEGEND

● CITIES-TOWNS

○ COUNTY SEAT

ROADS-HIGHWAYS

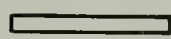
———— STATE HIGHWAY U. S. HIGHWAY

----- RAILROADS

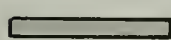
 STREAMS-LAKES

-.-.-. COUNTY BOUNDARY

 INDIAN RESERVATION

 PRIVATELY OWNED LAND

 STATE OWNED LAND

 FEDERAL OWNED LAND

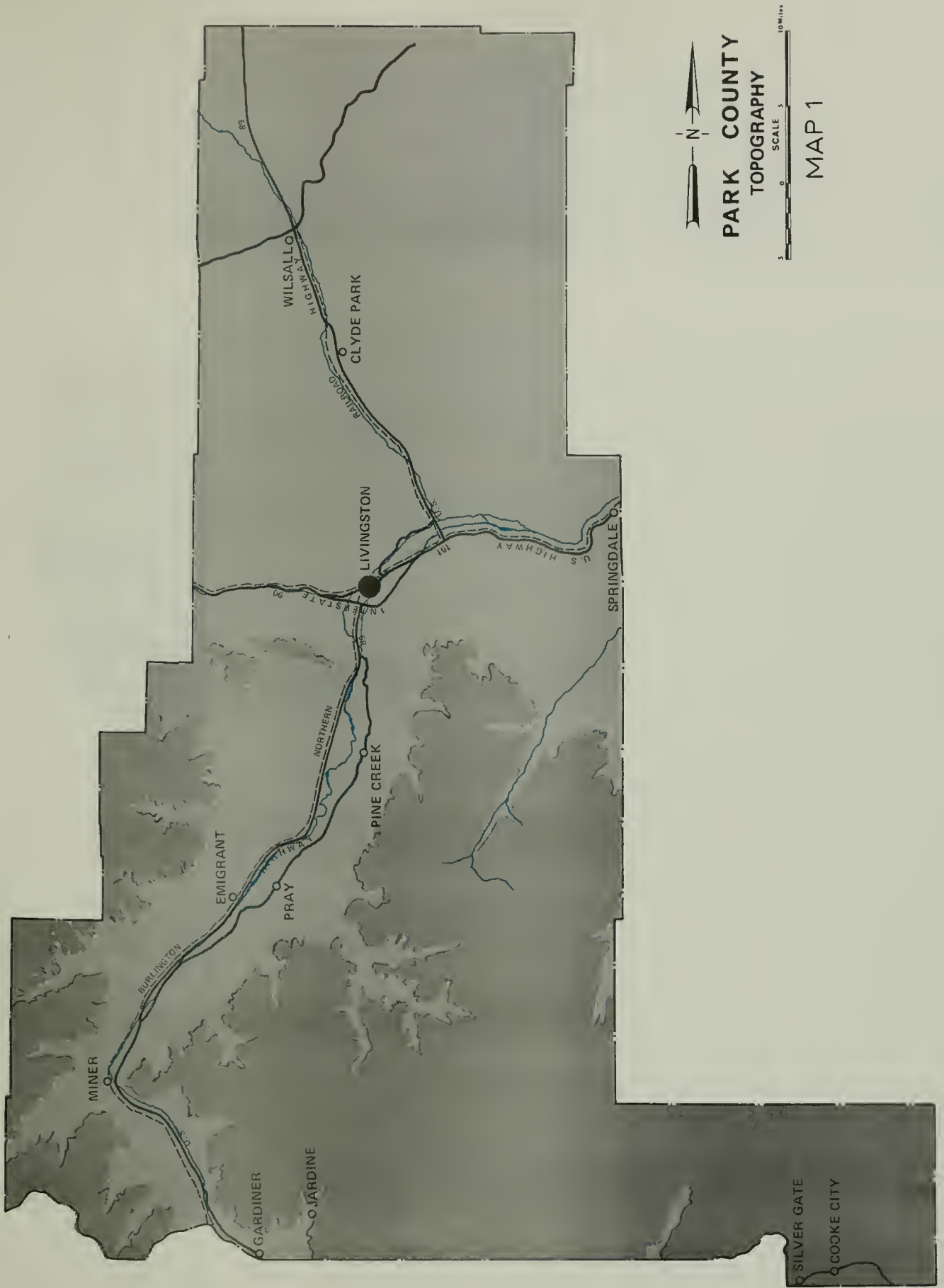
CITIES MAP LEGEND

LAND USE

-  SINGLE RESIDENCE
-  DILAPIDATED RESIDENCE
-  SINGLE TRAILER RESIDENCE
-  MULTIPLE RESIDENCE
-  APARTMENTS
-  TRAILER COURT
-  COMMERCIAL BUILDING
-  HOTEL-MOTEL
-  PUBLIC BUILDING
-  SCHOOL
-  CHURCH
-  HOSPITAL
-  INDUSTRIAL
-  GRAIN ELEVATOR

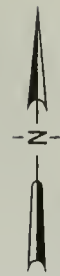
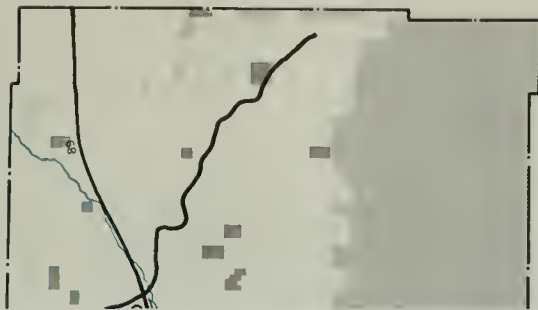
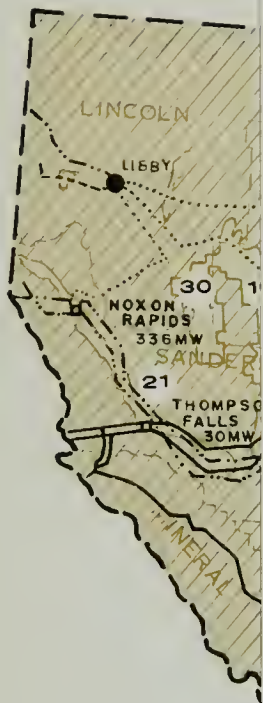
WATER and SEWER SYSTEMS

-  EXISTING LINES AND SIZES
-  PROPOSED LINES 5-10 YEAR
-  PROPOSED LINES 10-20 YEAR
-  EXISTING LIFT STATION
-  PROPOSED LIFT STATION
-  EXISTING WATER STORAGE TANK
-  PROPOSED WATER STORAGE TANK
-  EXISTING WATER SOURCE
-  PROPOSED WATER SOURCE
-  EXISTING TREATMENT FACILITIES
-  PROPOSED TREATMENT FACILITIES
-  SERVICE AREA 1970-1980
-  SERVICE AREA BY 1990



PARK COUNTY
TOPOGRAPHY

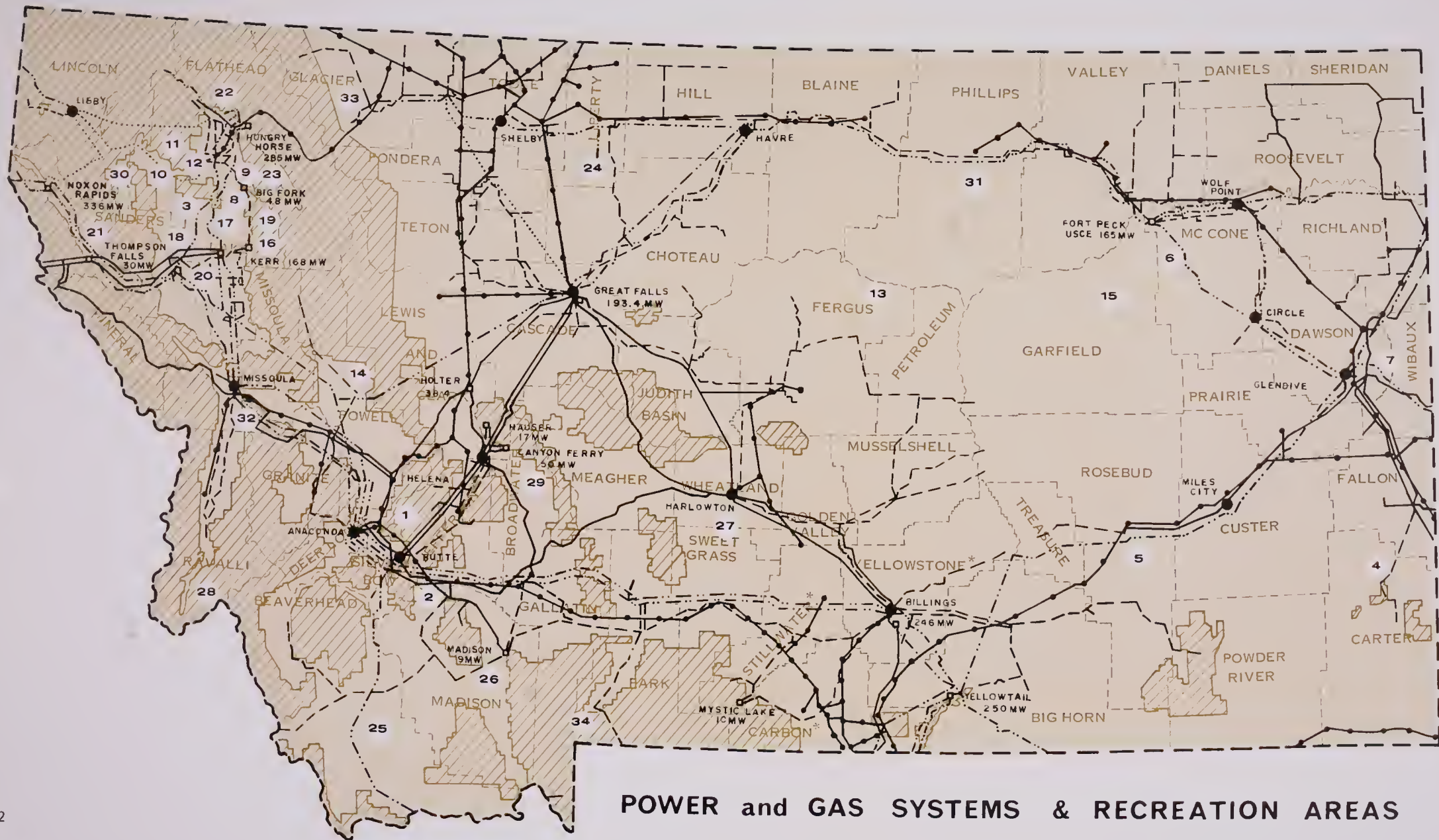
MAP 1

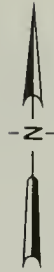
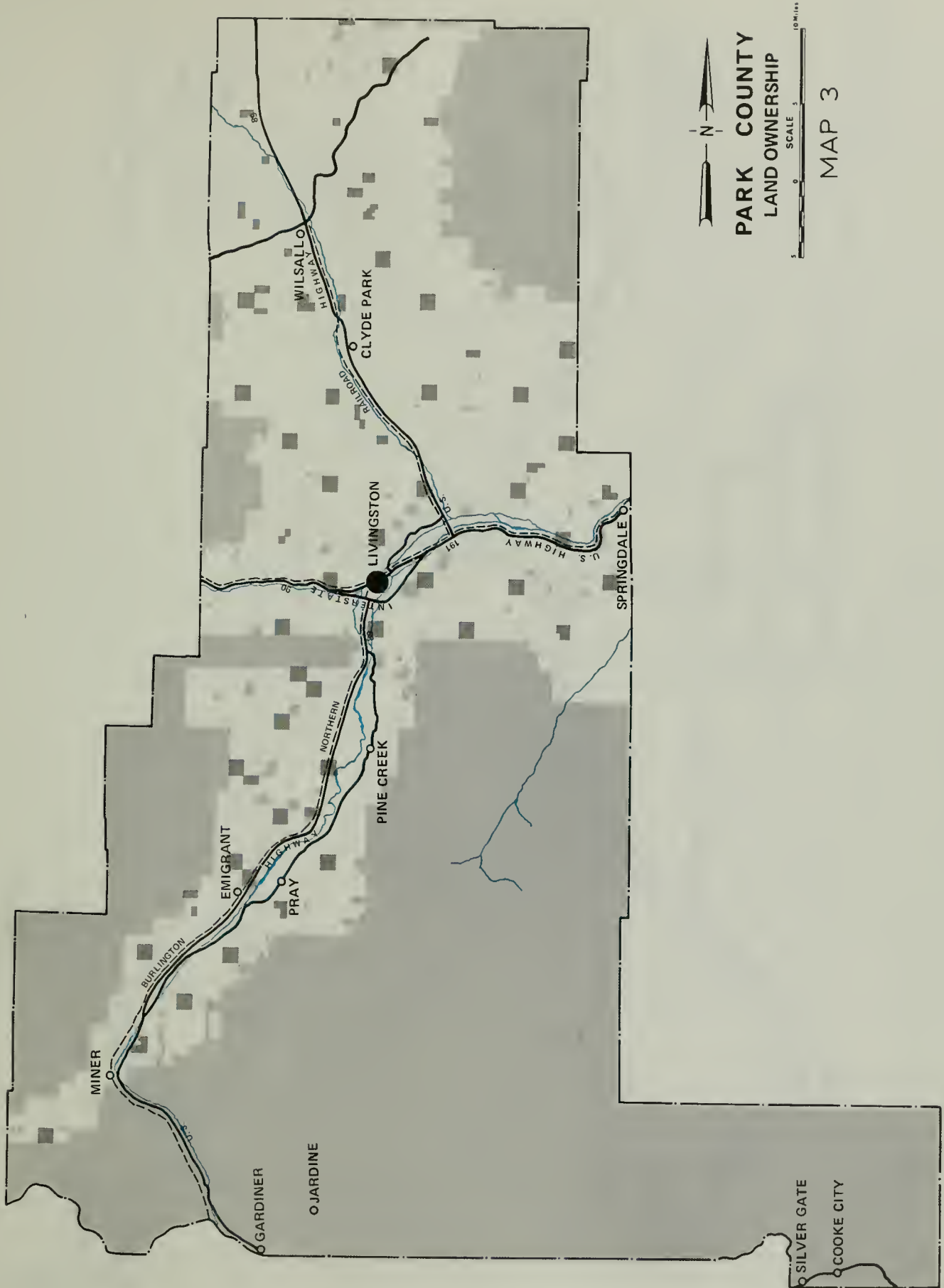


**PARK COUNTY
LAND OWNERSHIP**



MAP 3

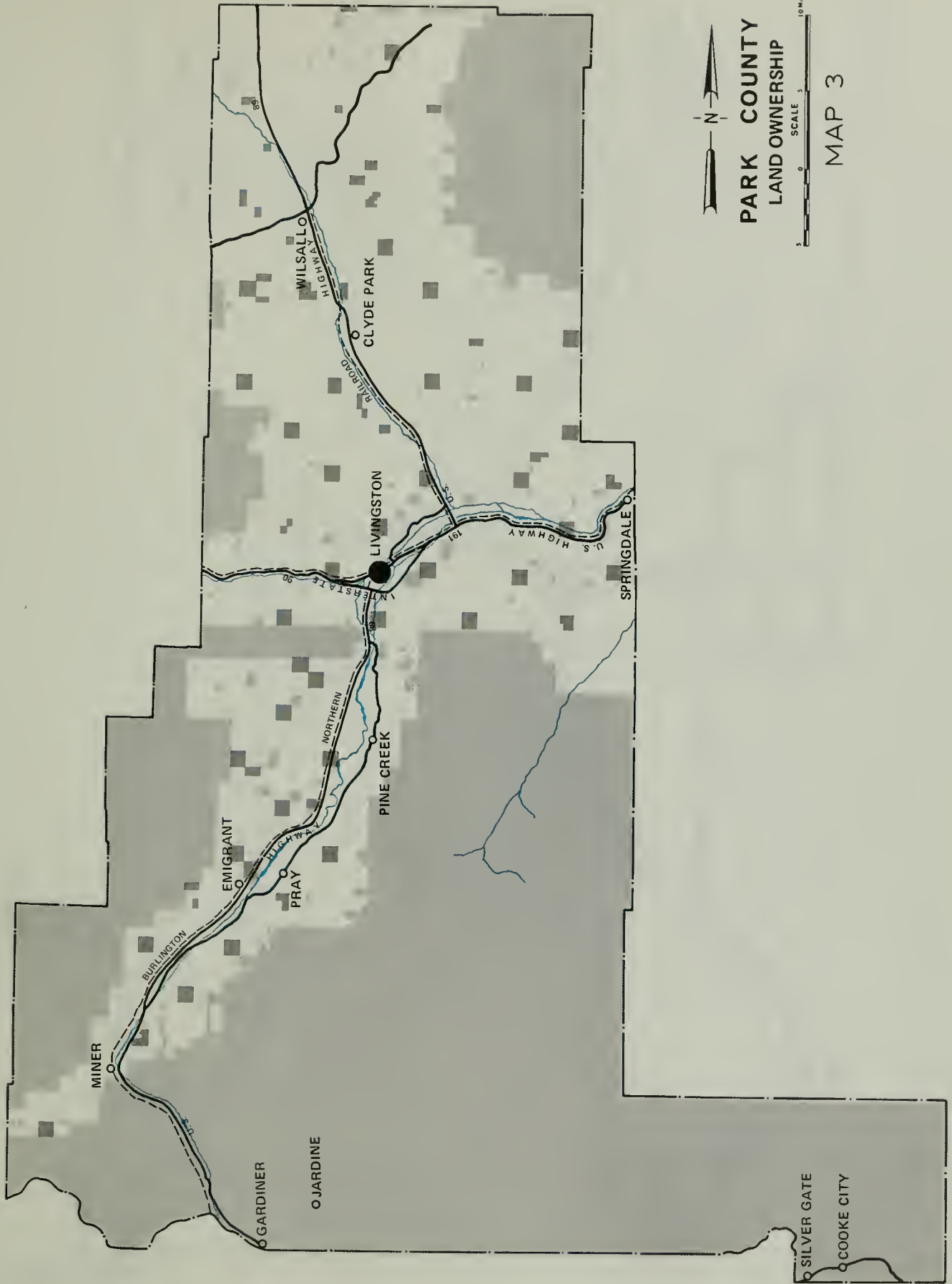




PARK COUNTY
LAND OWNERSHIP



MAP 3



PARK COUNTY
LAND OWNERSHIP

MAP 3

SPRINGS
200 G.P.M.
300,000 GAL.

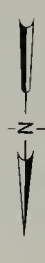
36,000 GAL.

GARDINER
WATER SYSTEM
SCALE
1" = 100'
1" = 200'
1" = 400'
MAP 5

SUPPLY FROM RIVER 350 G.P.M.
30,000 GALLON CLEAR WELL

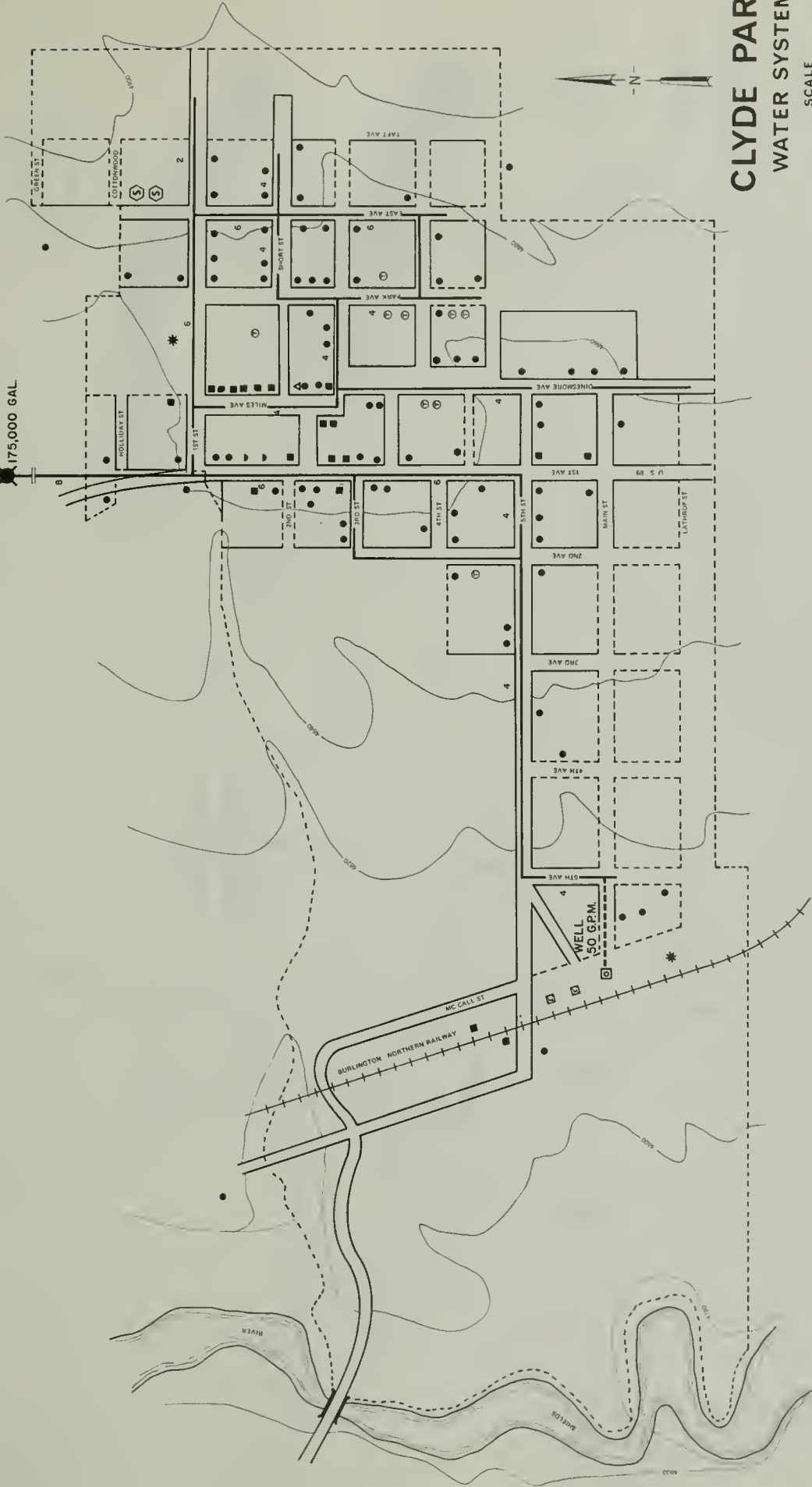




 **WILSALL**
WATER SYSTEM
SCALE 0 200 400 800
MAP 6

SUPPLY LINE FROM SPRINGS
100 G.P.M.

175,000 GAL



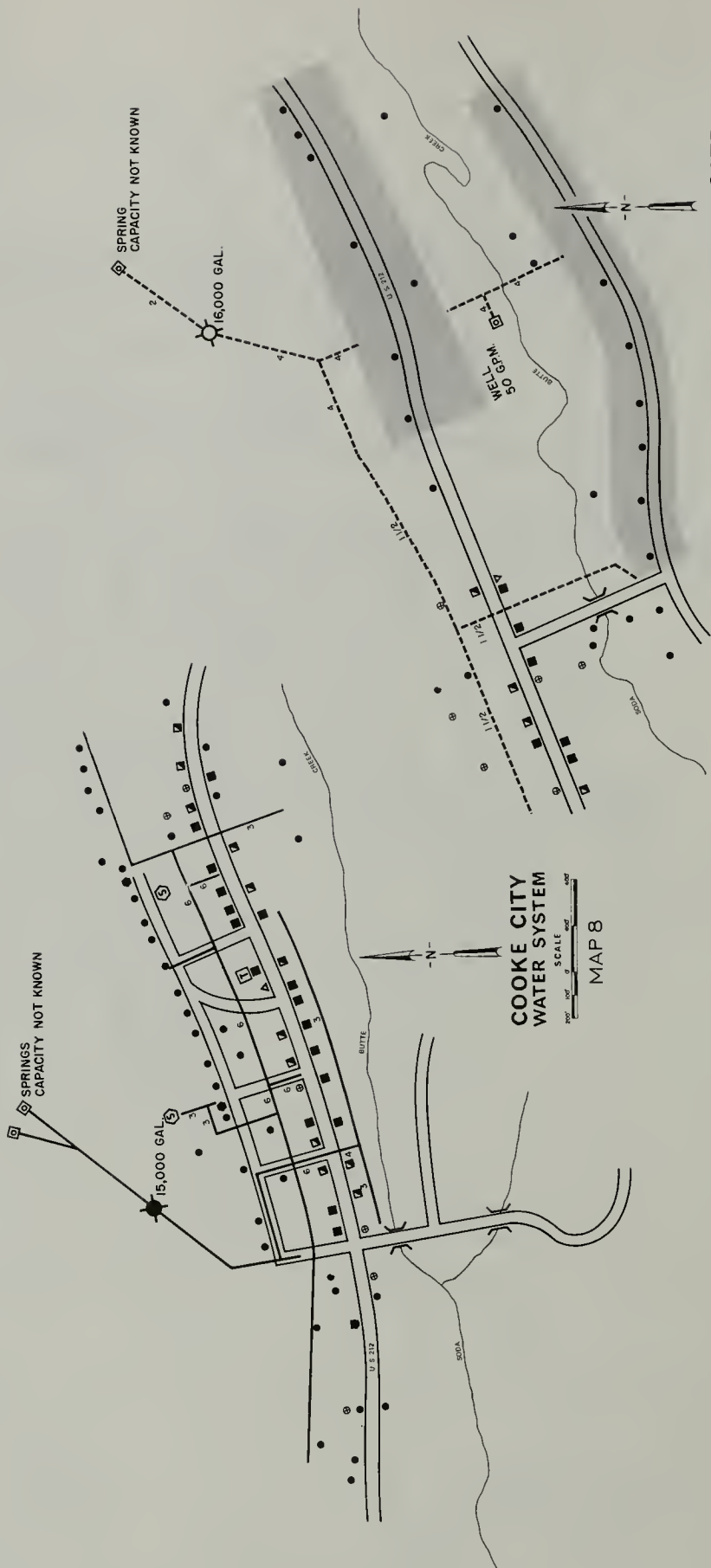
CLYDE PARK WATER SYSTEM

SCALE
1" = 100'
1" = 200'
1" = 400'

MAP 7

SPRINGS
CAPACITY NOT KNOWN

15,000 GAL.



COOKE CITY
WATER SYSTEM

SCALE
0 100 200
FEET

MAP 8

SPRING
CAPACITY NOT KNOWN

16,000 GAL.

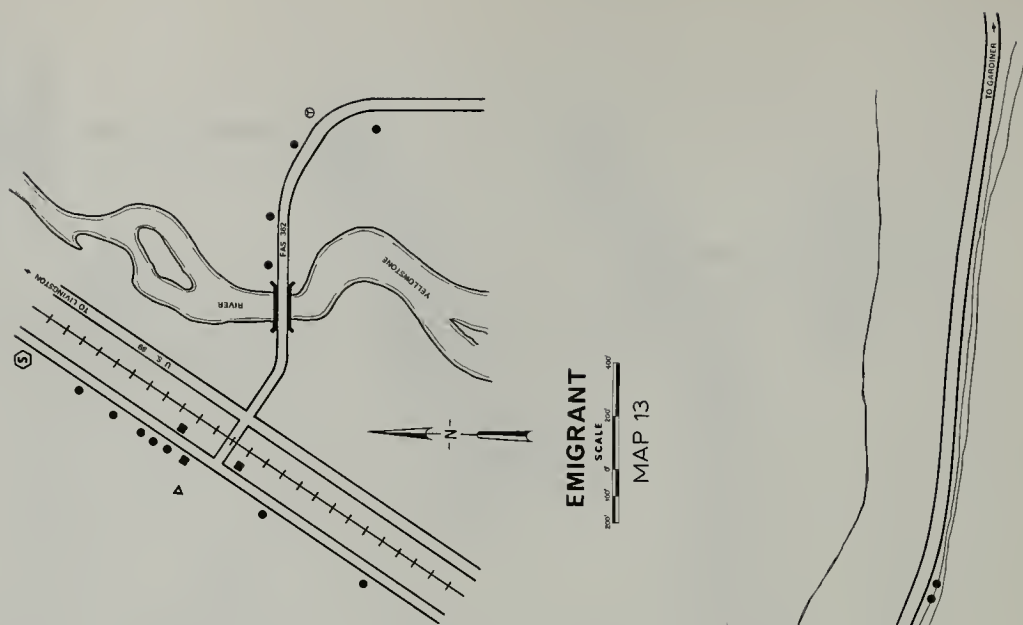


SILVER GATE
WATER SYSTEM

SCALE
0 100 200
FEET

MAP 9

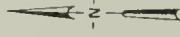


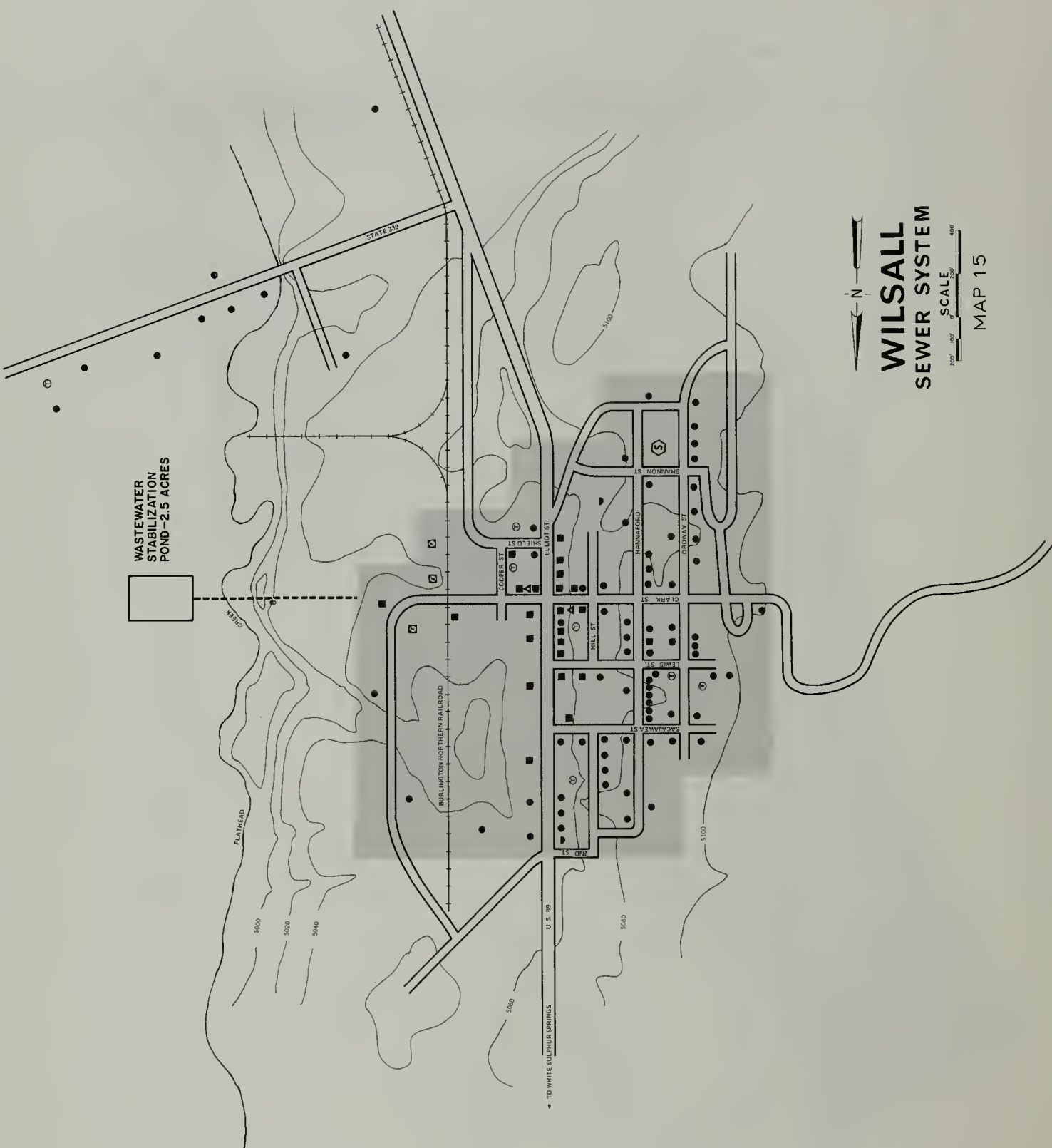


GARDINER
SEWER SYSTEM

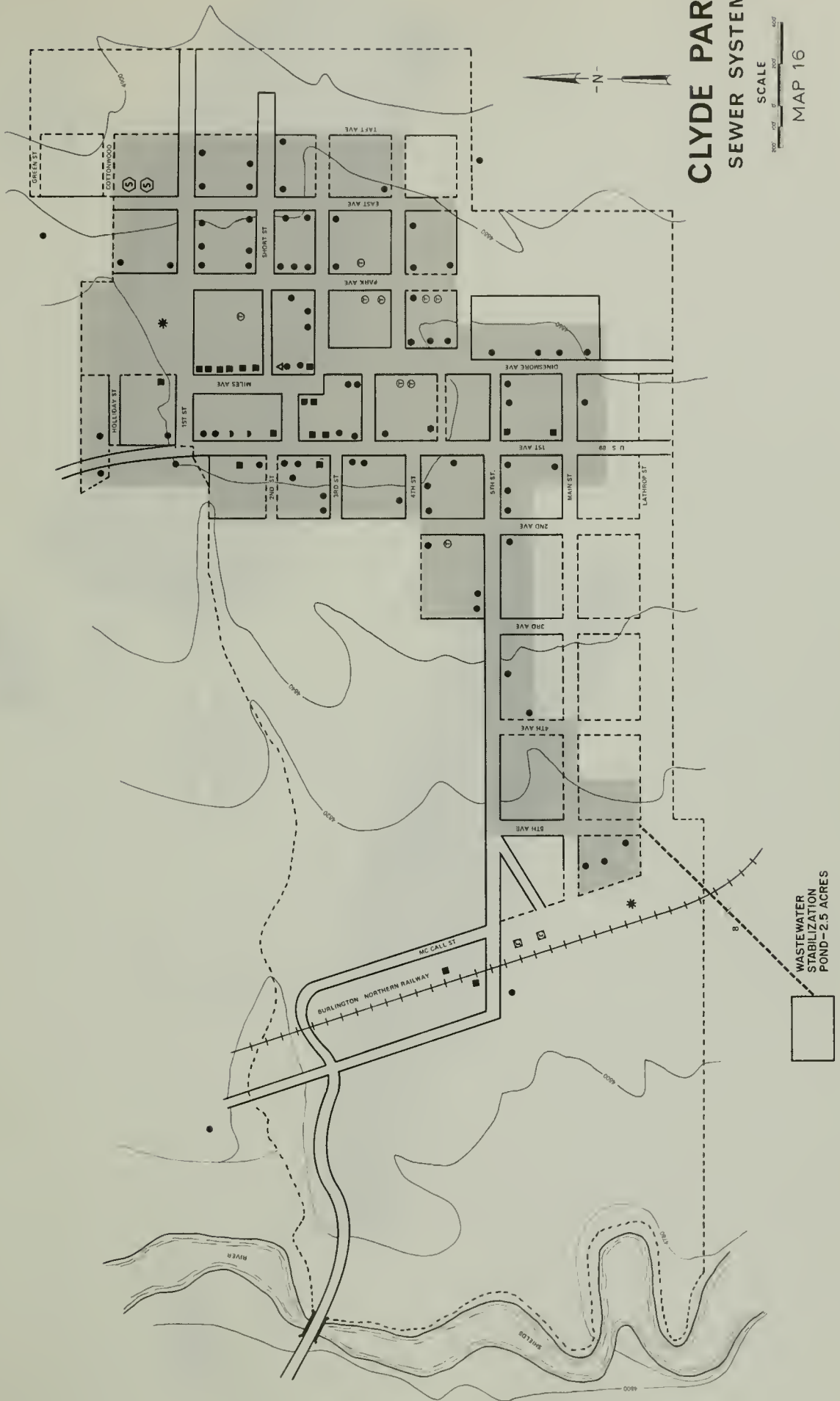
SCALE 1" = 400'

MAP 14





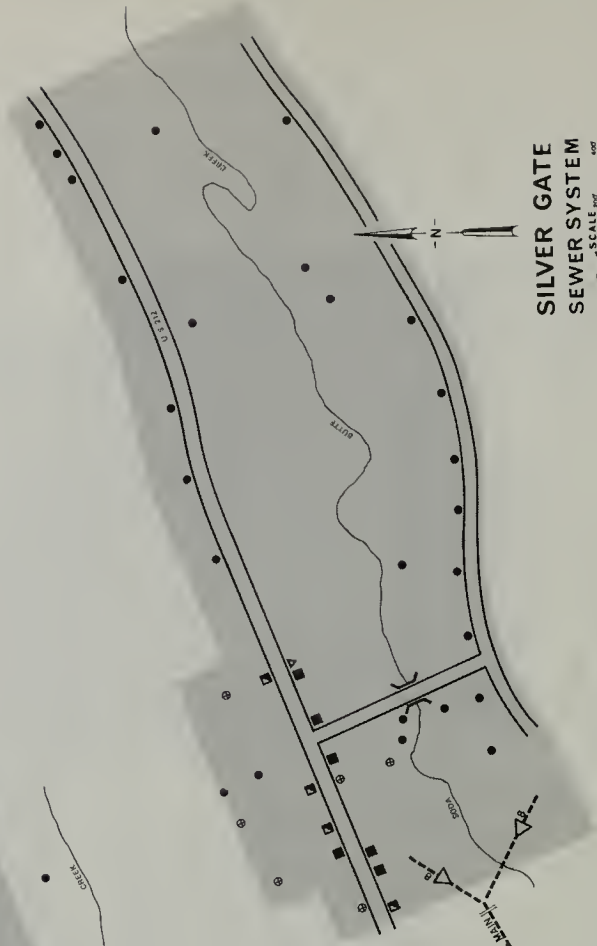
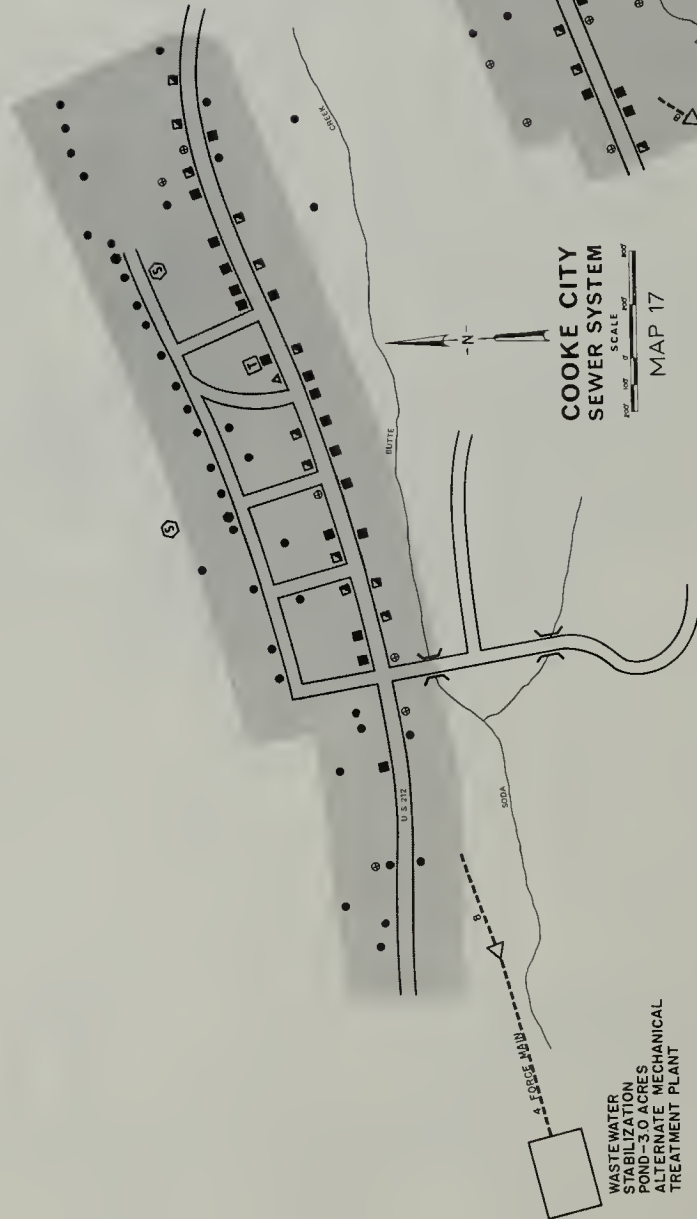

WILLSALL
SEWER SYSTEM
SCALE 1" = 400'
MAP 15



CLYDE PARK SEWER SYSTEM

SCALE
1" = 100'
0 100 200 300 400 500 600 700 800 900 1000
MAP 16

WASTEWATER
STABILIZATION
POND - 2.5 ACRES



SWEET GRASS COUNTY

MONTANA

SWEET GRASS COUNTY

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CONCLUSIONS, RECOMMENDATIONS, AND PRIORITIES

Conclusions

The total population of Sweet Grass County is expected to decrease throughout the planning period. This decrease is expected to take place throughout the rural areas of the county. Big Timber, the largest town in the county, is expected to increase in population through 1990. This is the only community which presently has central water and sewer facilities. The other communities do not have sufficient population to warrant the installation of central facilities. These communities all have developed adequate water and sewer facilities through the use of private wells and septic tanks.

Sanitary facilities presently in existence at Big Timber provide water and sewer service to practically every residence. The sewer system adequately handles sewage flows and has sufficient capacity for expansion to serve additional population. The water system is adequate throughout most of the year; however, water shortage is experienced during high demand periods of the summer. Expansion and improvements to the water system have been proposed, and these are the only major improvements necessary in the county.

Recommendations

This plan shows the various types of improvements which the communities should be considering during the planning period. Elaborate systems are not proposed but rather those facilities necessary to provide safe and adequate community systems. It is recommended that this general plan be adopted by the governing agencies of each community. A detailed approach, which must be undertaken to insure completion of the improvements in each community, cannot be covered in a report of this type. Community leaders, however, do have several courses of action which may be taken.

Most small communities do not have the means to plan and finance complete water and sewer systems. Therefore, to enable communities to acquire such facilities, five departments of the Federal Government have legislation authorizing loans or grants for construction of public works. These agencies are:

Farmers Home Administration
United States Department of Agriculture
P.O. Box 850
Bozeman, Montana 59715

Federal Water Quality Administration
United States Department of the Interior
% Montana State Department of Health
Helena, Montana 59601

Public Health Service
United States Department of Health, Education, and Welfare
Division of Indian Health
Billings, Montana 59101

Administration for Metropolitan Development
United States Department of Housing and Urban Development
Assistant Regional Administrator
Denver Regional Office
1050 South Broadway
Denver, Colorado 80209

Economic Development Administration
United States Department of Commerce
Montana Field Coordinator
207 Medical Arts Building
Butte, Montana 59701

The legislation is constantly changing; therefore, community leaders should investigate the various alternatives and determine which program and course of action would be most beneficial to them.

Priorities

That a particular system requires immediate improvements and another system will be satisfactory for a definite period are difficult to establish. Several indicators for establishing priorities are available, however. The general health of the people is the prime consideration, and this can only be insured when safe water supplies are provided. Water supply in adequate quantities is another important factor. Waste water must be treated and disposed of by safe methods to minimize the problems of pollution and to protect public health. The total number of persons benefited by any improvement must also be considered.

The only improvements necessary to sanitary facilities within the county are those proposed for Big Timber. It is necessary to develop increased water supply for the water system. Looping and expansion of the distribution system will also be necessary. A storage facility located near the center of the town will have a great affect on equalizing pressures in the distribution system. The first improvement should be to clean and possibly extend the infiltration

gallery located just south of the town. The capacity of this facility should be enlarged so that the existing pumping facilities can operate at capacity. Secondly, the looping of the distribution system should take place. New water supply should also be developed, and this can be done with a new infiltration gallery or an additional supply line to the existing reservoir. The need for additional storage in the town can best be determined after these other improvements have been made.

THE LAND

General Characteristics

Sweet Grass County is located in the south central part of the State of Montana and is bordered by four counties. Park County borders to the west and south, Stillwater County lies to the east, Golden Valley County forms the irregular northeast corner, and Wheatland County joins on the northern edge. The total area is 1,849 square miles of which only three square miles represent water surface. The Yellowstone River, Boulder River, Glasston Lake, and Lake Adam account for the majority of this water surface area.

As seen from the topography on Map 1, Sweet Grass County is characterized by land that changes from rolling plains in the central and northeastern portions to high rugged mountains in the southern and northwestern parts of the county. Elevations vary from 11,298 feet above sea level at Mt. Douglas in the Absaroka Range and 11,230 foot high Crazy Peak in the Crazy Mountains to elevations as low as 3,900 feet between the mountain ranges in the eastern part of the county in the Yellowstone River valley. The population is generally spread along the Yellowstone Valley.

There are two federal highways and two secondary state highways serving Sweet Grass County. U. S. Highway 10 traverses from Billings to Bozeman passing through Greycliff and Big Timber parallel to the Yellowstone River. U. S. Highway 191 enters the county from the west, and joining U. S. Highway 10 until Big Timber, branches northward into Wheatland County. State Secondary Highway 298 travels south out of Big Timber, the county seat, through McLeod along the Boulder River and serves the southern county area. State Secondary Highway 371 serves Melville and the Sweet Grass Creek area in the northern areas. Numerous county roads serve the remaining rural areas.

Rail transportation is provided by a main line of the Burlington-Northern Railroad which generally parallels U. S. Highway 10 and the

Yellowstone River. Numerous freight trains and two passenger trains, the Mainstreeter and the North Coast Limited, pass through Big Timber daily.

There are no commercial airports in the county; however, Big Timber is the site of a 4,800 foot unpaved airfield with boundary lights, beacon, and unicom. The facility is open for public use with limited aircraft servicing accommodations.

The Park Electric Cooperative, Inc. provides power service to the county. Centered in Livingston, this electric cooperative purchases two thirds of its power from the Bureau of Reclamation and one third from the Montana Power Company. The latter delivers almost all the power in the area over their transmission lines.

Since major power producing centers and relay stations are usually located at widely separated points and provide power service to large areas, Map 2 shows the major power grid system for the entire State of Montana. Major gas transmission lines are also shown.

Telephone service is provided by the Treasure State Telephone Company. The county is divided into three basic telephone districts: the Melville district which serves the northern portion; the Big Timber district which serves the central and southern portions; and the Reed Point district which serves a small part of the east central segment of the county.

Land Ownership and Use

As seen on Chart 1, there are three main categories of land owners in Sweet Grass County. The largest segment of land, seventy one percent, is privately owned. Twenty four percent, or about 440 square miles, is federal land consisting primarily of the Gallatin, Custer, and Lewis and Clark National Forests. The remaining five percent of the county's land is state owned.

The land use of the county is reflected by the general physical characteristics of the area. Over three fourths of the area is used for agricultural purposes with the largest share of the remaining area, twenty two percent, consisting of forested areas in the southern and northwestern parts of the county. Only one percent of the county consists of water surface area and land used for townsites, transportation routes, and similar purposes not included in the above general categories.

CHART 1

Land Ownership
Sweet Grass County

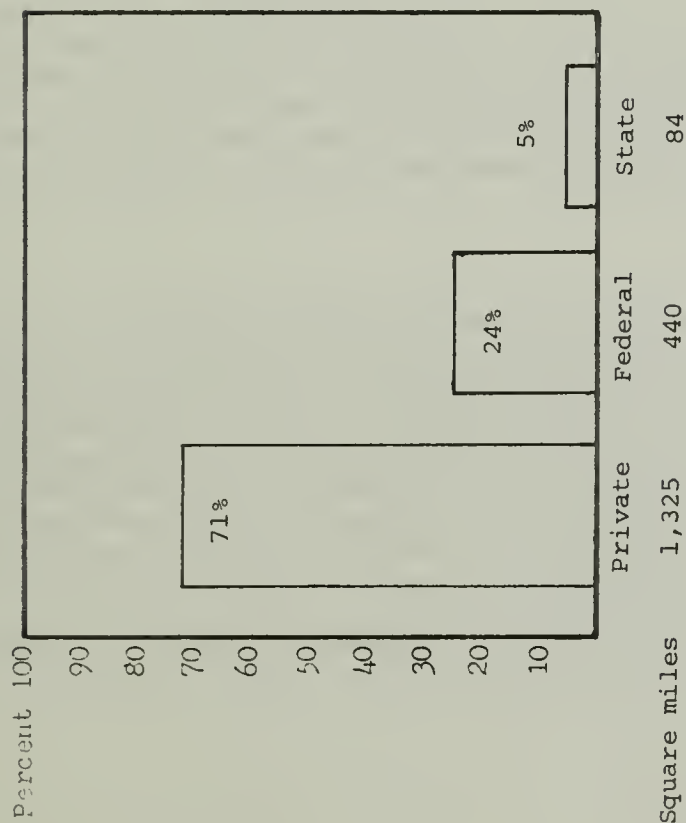
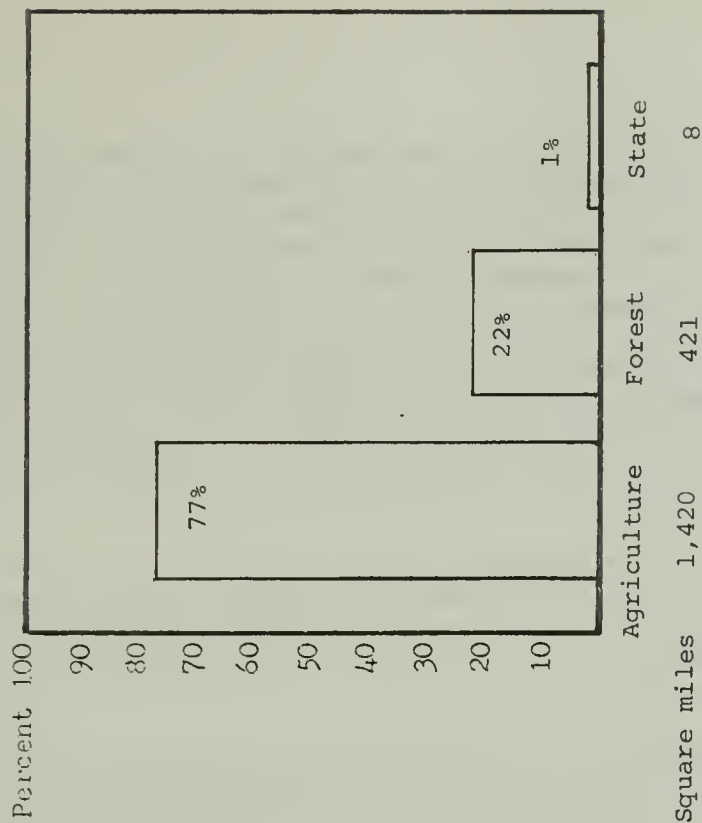


CHART 2

Land Use
Sweet Grass County



Sources: 1. The Montana Almanac, 1959-60
2. Forest Service, U. S. Department of Agriculture

Natural Resources

The national forests are a prime natural resource to Sweet Grass County. The largest forest area is the 197,926 acres located in the southwestern and northwestern portions of the county and is part of the Gallatin National Forest. The Custer National Forest covers 81,615 acres in the southeastern corner of the county. The Lewis and Clark National Forest in the northern part of the Crazy Mountains extends down into a very small portion of the northwest corner covering only four square miles of land area. These three national forests areas contributed \$2,232.03, \$2,422.67, and \$32.55 respectively to the county in 1969 as their share of the gross national forest receipts from timber, grazing, land use, recreation, power permits, and mineral leases.

Other natural resources include sand and gravel extracted for commercial use. In 1966 the value of the product was \$113,000 while in 1967 the amount had declined to \$14,000. The amount used, presently, is dependent almost entirely upon local demand for road maintenance and construction materials.

The two mountain ranges, the Crazy Mountains to the north and the Absaroka Range to the south, provide excellent recreational opportunities. The Boulder River flowing north through the Absaroka Range has many excellent camping facilities as well as dude ranches and other types of recreation to suit the person seeking a retreat from the fast paces of society. Excellent fishing is available on the blue ribbon trout streams. Wild game such as deer, elk, moose, and even an occasional bear may be hunted in the mountain areas while pronghorn antelope roam the plains in the central areas. The future of recreation is good in the county, and as that industry develops it will play an increasingly important role in the area's economy.

Soils

Generally, the soils of the middle and eastern portions of Sweet Grass County are of the agriculture supporting type. Less than ten percent of the agricultural land is utilized for crop production primarily because of the rather arid conditions. The grass lands are of an excellent quality for grazing purposes as implied by the county name of "Sweet Grass." The soils of the southern and northwestern portions are of an alpine nature supporting excellent forest growths and some grassland. A few soils in the high county are too stoney to support any substantial growth at all.

Specific details about soils will be covered later in this report.

Water

The Yellowstone River, a portion of the Missouri River drainage basin and flowing from west to east through the center of the county, is the primary drainage for the area. The Boulder River, which flows from the extreme southern border of the county, and other creeks south of Big Timber all flow northward into the Yellowstone. Sweet Grass Creek begins in the northwest corner of the county and serves as the main drainage system for the north portion with this creek and other creeks north of Big Timber flowing south into the Yellowstone River. A very small portion of the northeastern part of the county is drained north into the Musselshell River.

Water resources are covered in more detail later in this report.

THE PEOPLE

Population

For analytical and projective purposes, it is necessary to study the population history of Sweet Grass County to find out what has happened and what is expected to happen. Chart 3 graphically shows the growth of the county as compared with that for Montana and indicates the future growth for both.

Without exception, the number of persons in the county decreased in each ten year census period since 1920. Between that year and 1930 almost one fifth of all persons left the county, the largest loss of any period. Only six percent moved during the depression and drought years of the 1930's. The estimated 1970 population is fifty nine percent of the 1920 total, and the 1990 number will drop down to under half.

Sweet Grass County was classified as a rural area in 1960 containing no urban areas and being located neither in nor near a major aggregate of urban population. The changes in the urban and rural population characteristics are shown in Table 1. Even though both groups have consistently been losing population over the past twenty years, the urban losses have not been as great as those in the rural areas. Within the rural categories, the loss rate in the farm segment greatly exceeds that for the non farm group. The total population has slowly been urbanizing since 1950. In that year forty six percent of the people lived in an incorporated town. The figure moved to fifty one percent in 1960 and to a present estimated fifty four percent. The farm population during that period dropped from forty six percent to thirty eight percent while the rural non farm

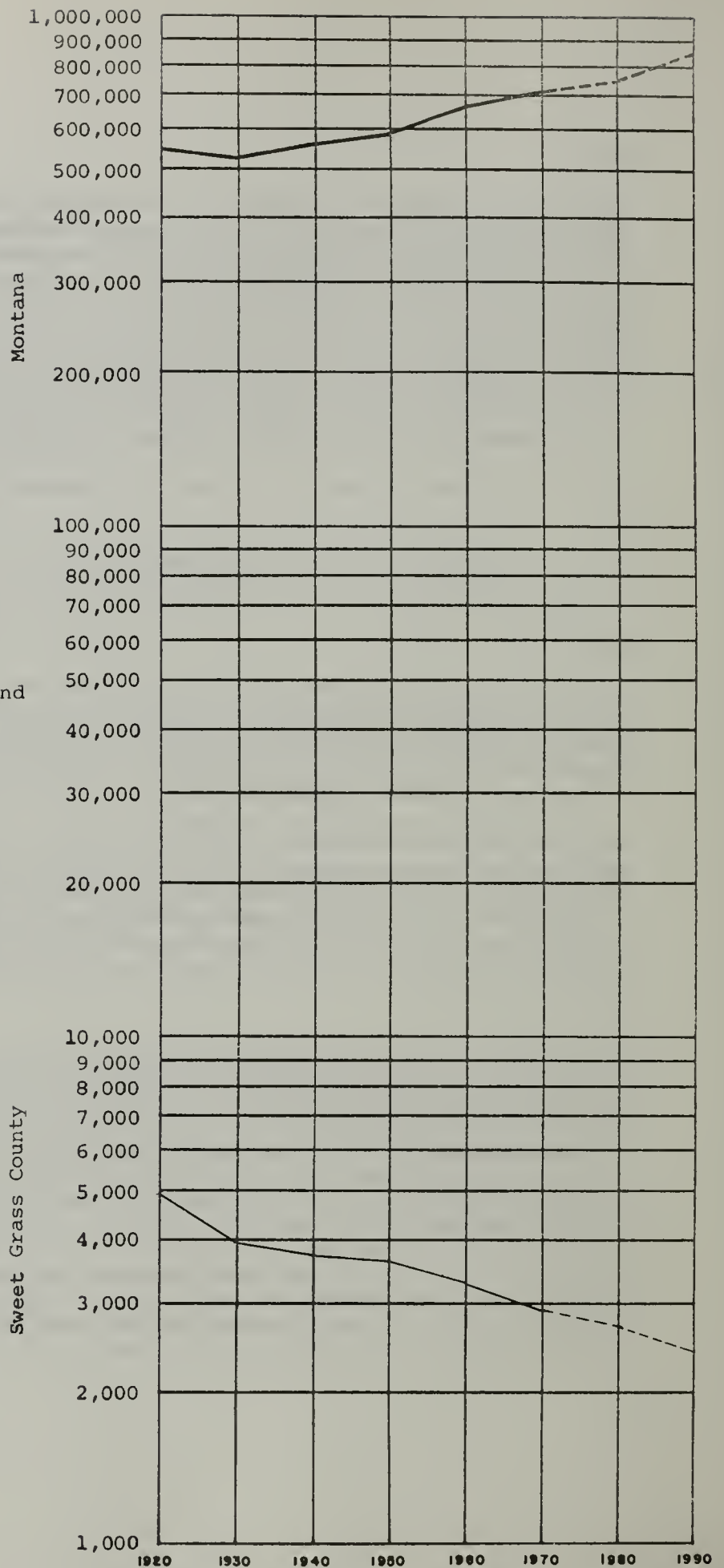
CHART 3

COMPARATIVE
POPULATION
TRENDS

Sweet Grass County and
Montana

Sources:

1. U.S. Census of
Population
2. Intermountain
Planners, Inc.



group remained fairly stable.

TABLE 1
Urban-Rural Population Changes for Sweet Grass County
1950-1970

	<u>1950</u>	<u>1960</u>	<u>Changes Number</u>	<u>1950-1960 Percent</u>
Total	3,621	3,290	-331	- 9.1
Urban				
(Inc. Towns)	1,679	1,660	- 19	- 1.1
Rural	1,942	1,630	-312	-16.1
Farm	1,675	1,380	-295	-17.6
Non Farm	267	250	- 17	- 6.4
	<u>1960</u>	<u>1970</u>	<u>Changes Number</u>	<u>1960-1970 Percent</u>
Total	3,290	2,900	-390	-11.9
Urban				
(Inc. Towns)	1,660	1,550	-110	- 6.6
Rural	1,630	1,350	-280	-17.2
Farm	1,380	1,100	-280	-20.3
Non Farm	250	250	0	0.0

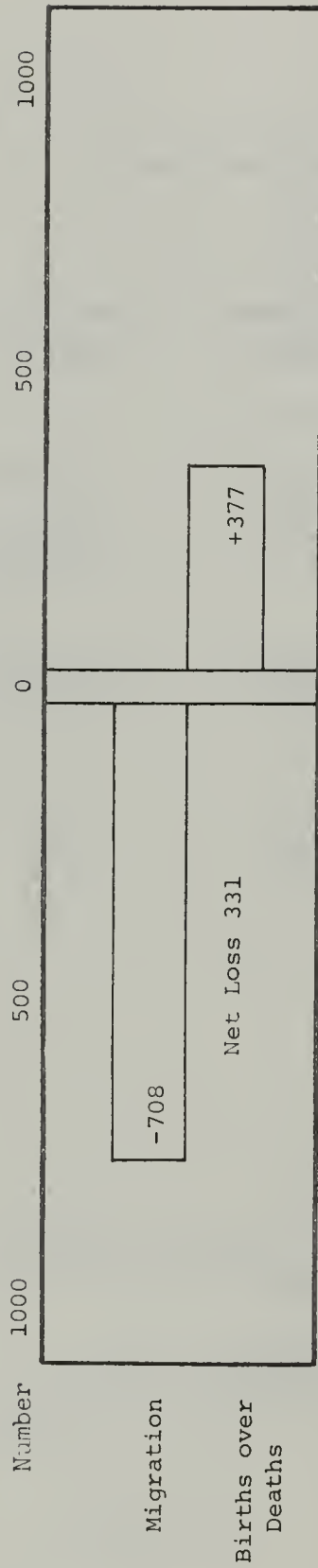
Sources: 1. U. S. Census of Population
2. Intermountain Planners, Inc.

During the ten year period from 1950 to 1960 the population declined by 331 persons. The decrease is a result of a net migration loss of 708 persons and an excess of 377 births over deaths.

The 1950 to 1960 change in sex composition is shown in Chart 5. The preponderance of males to females declined slightly resulting in only a very small 1960 lead. The ratio should remain stable throughout the twenty year planning period.

CHART 4

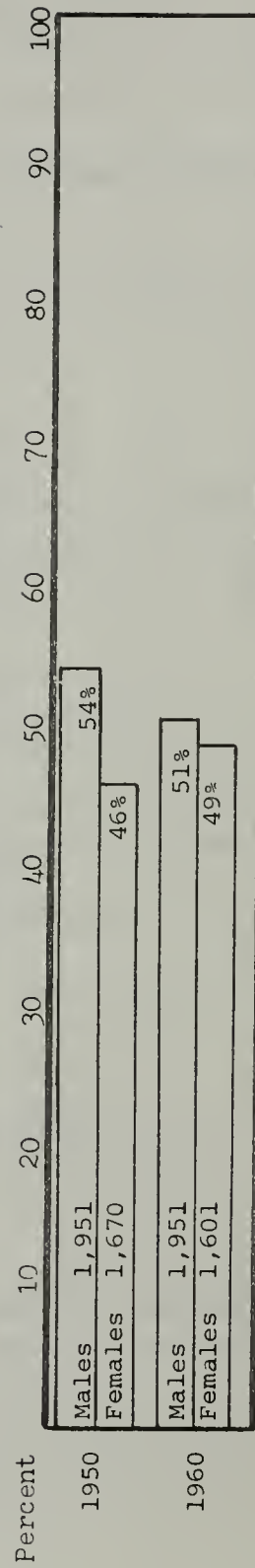
Population Change
Sweet Grass County 1950 - 1960



Source: Net Migration of Population, 1950-1960 by Age, Sex, and Color,
U. S. Department of Agriculture

CHART 5

Population by Sex
Sweet Grass County 1950 - 1960



Source: U. S. Census of Population, 1950-1960

The age distribution by sex for 1950 and 1960 is shown in Table 2. Increases in total numbers occurred within the over sixty five years age groups.

TABLE 2

Age & Sex Composition of Sweet Grass County

Age Group	1950		1960	
	Male	Female	Male	Female
Under 5	183	183	160	181
5-14	320	295	303	326
15-19	146	124	119	107
20-24	117	112	73	69
25-34	241	224	178	167
35-44	272	243	186	186
45-54	231	159	212	191
55-64	240	173	187	146
65-74	142	109	187	154
75 +	59	48	84	74
Total	1,951	1,670	1,689	1,601

Source: U. S. Census of Population, 1950-1960

A total of four towns and communities were studied in Sweet Grass County. The list includes the incorporated town of Big Timber and the three unincorporated communities of Greycliff, McLeod, and Melville.

Because of the time that has elapsed since the 1960 Census, current population estimates had to be derived from several sources in the field. Surveys and interviews were conducted to determine what now exists and what is expected in the future. Table 3 indicates the past population experience and future projections for each town and community.

The major population center of Sweet Grass County will continue to be in and around Big Timber. The 1990 population will be approximately 1,900, or a nine percent increase over the present figure. The anticipated population will require an additional fifty new dwelling units, and these homes are expected to be developed

southerly of the existing town.

TABLE 3

Population Forecast for Towns and Communities

Sweet Grass County

	<u>1950</u>	<u>1960</u>	<u>1970</u>	<u>1975</u>	<u>1980</u>	<u>1990</u>
Big Timber	1,679	1,660	1,750	1,800	1,850	1,900
Greycliff	85	75	35	30	25	20
McLeod	15	15	10	10	10	10
Melville	24	15	15	12	10	10

Sources: 1. U. S. Census of Population, 1950-1960

2. Intermountain Planners, Inc.

The number of persons in McLeod will remain stable while the population in Greycliff and Melville will decline over the next twenty years.

The population figures reflect only those factors and trends for which information is available. New technological advances, new industries, or other unforeseen events may alter these projections. If such an event occurs, the affected areas should be examined in view of the new conditions.

Housing

In 1960 there were 1,196 housing units within the county. Chart 6 indicates that over two thirds were classified as rural non farm and the remainder as farms. Since the county lacked any recognizable urban center in 1960, there was no urban classification of housing units as found elsewhere in Montana. The median housing unit size was 4.90 rooms per unit, and the median household size per occupied unit was 3.06 persons. Of those units, almost two thirds were owner occupied while twenty seven percent were used for rental purposes. Chart 7 indicates that eleven percent were vacant. The condition of housing in 1960 is reflected in Chart 8 which indicates that only four percent were in need of replacement while one home in eight

needed repair. The remainder were classified as sound.

In 1960 just over half of all homes were served by a public water system or by a private company. Those served included eighty one percent of the rural non farm homes and none of the farms. Farms generally obtained water from individual wells as did sixteen percent of the rural non farm homes; almost one farm in five, however, did rely on another source for water.

Only ten percent of the homes in the county did not have piped water in 1960. The figure includes one home in ten in the rural non farm areas and a similar amount of the farms. A public sewer provided service to just under half of the homes in 1960. As with water systems, no public sewers were available in farming areas but rather just to the rural non farm areas. Two thirds of all homes in the last category did have access to a public sewer, while one fifth relied on either a septic tank or cesspool for waste disposal. Almost three fourths of the farms used a septic tank or cesspool for sewage disposal. One fifth of all homes including fourteen percent of the rural non farm homes and twenty nine percent of the farms used still another method.

HOUSING
Sweet Grass County

Chart 6
Housing Classification

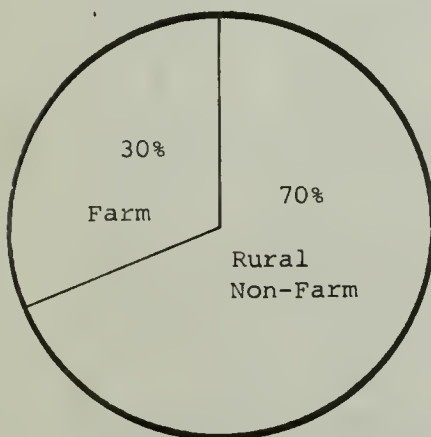


Chart 7
Housing Tenure

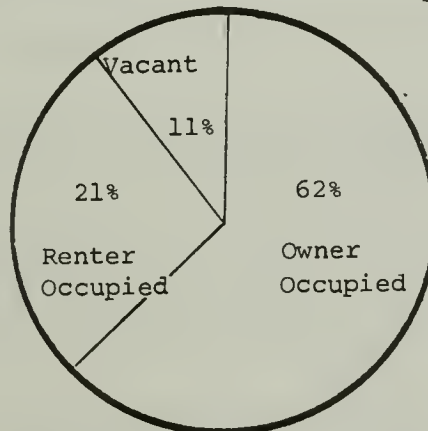
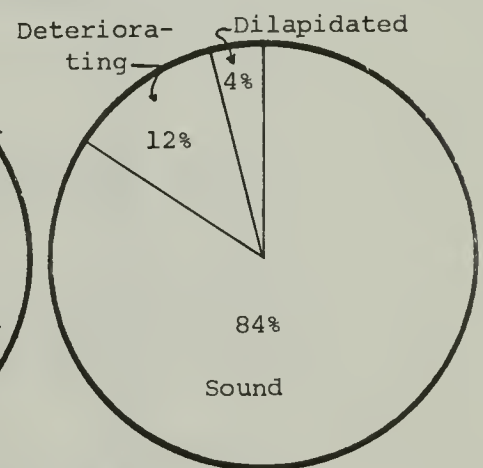
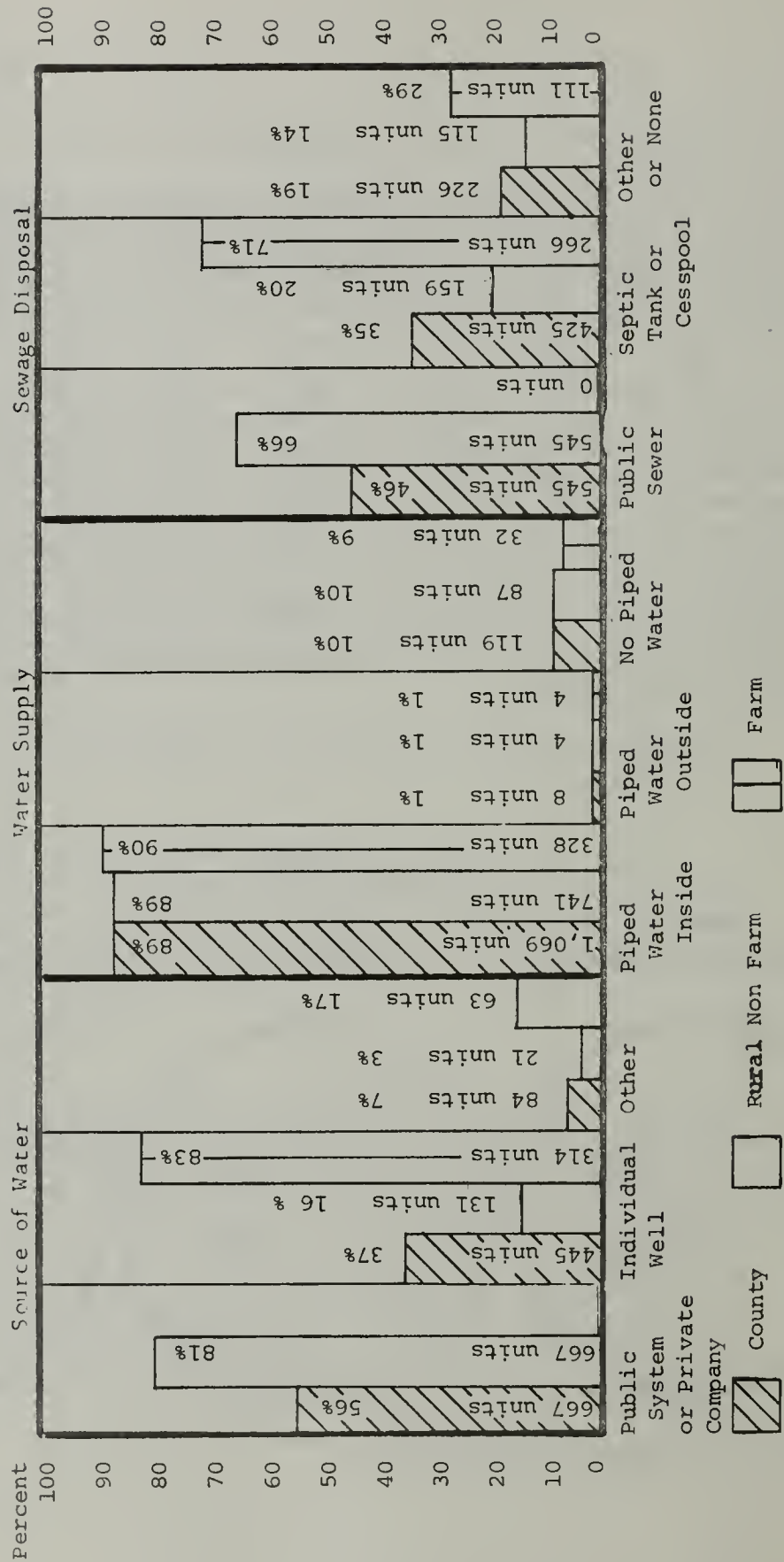


Chart 8
Housing Condition



Source: U. S. Census of Housing, 1960

CHART 9
Sewer and Water
Sweet Grass County, 1960



Source: U. S.. Census of Housing, 1960

Generally, the existing public water and sewer systems are in the urban population centers of the county. The 1960 housing data indicates that some deficiencies do exist in all categories.

THE ECONOMY

Labor

People have a direct relationship on the economy of an area because of their role as both producers and consumers of goods and services. The following economic analysis of Sweet Grass County is concerned primarily with the total economic spectrum and how it may affect the future of the area. Changing economic conditions can have either a good or a bad effect on a region in terms of population growth, ability to provide for public improvements, or in determining the general overall living environment.

Employment declined by nineteen percent between 1950 and 1960 while the population dropped nine percent during the same period. The loss in the labor force for the county is contrasted with a six percent gain for the state.

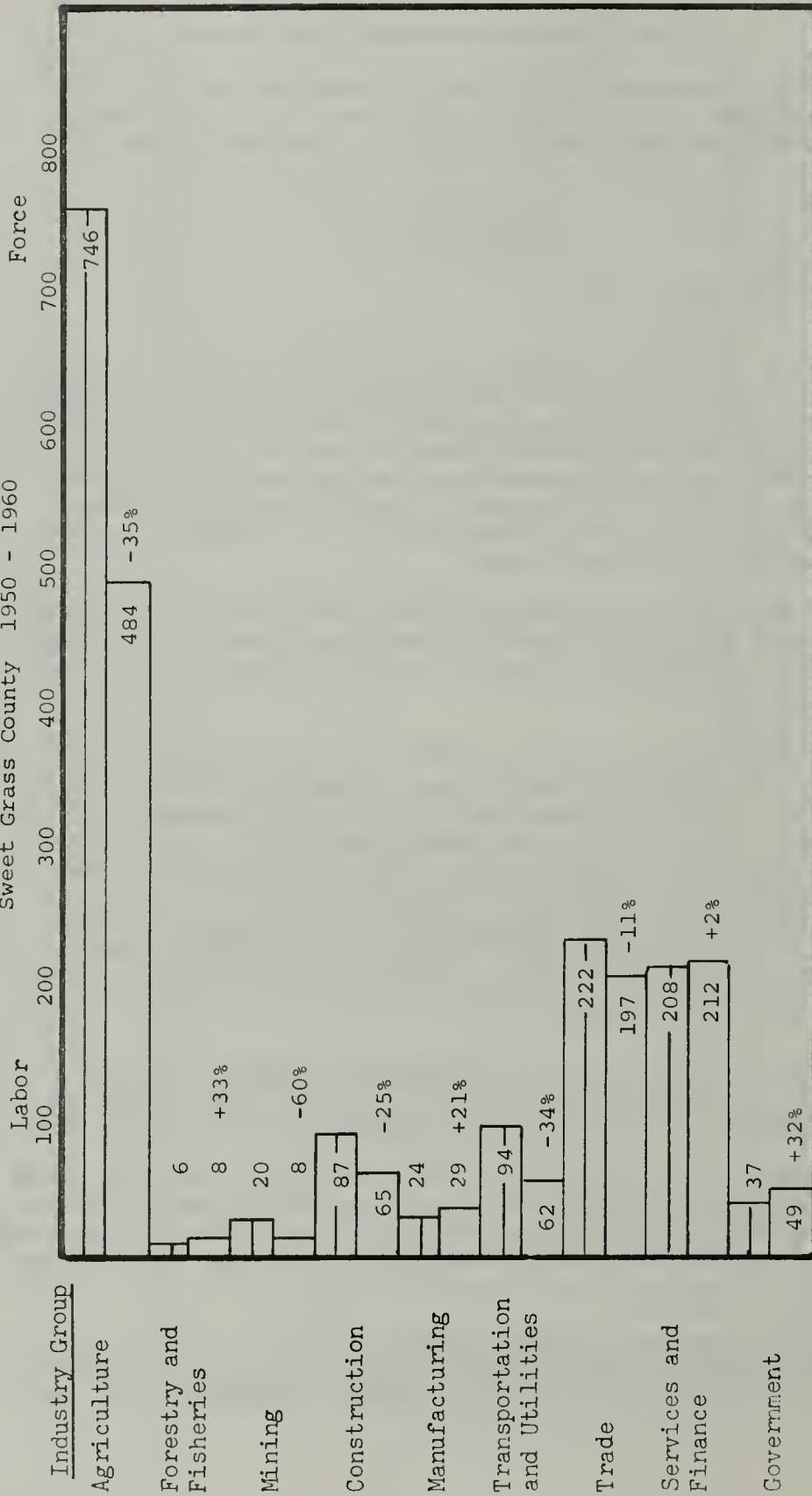
Past employment change by major industry groups is shown in Chart 10. In the ten year period the population of those males in the labor force fourteen years and older declined and an overextension of women in the labor market elevated the unemployment rate. Since work opportunities were enhanced for women alone, their share of available jobs was greatly extended. As of 1960 three of every ten employees were women. The number of men at work was curtailed by about thirty percent while jobs filled by women gained a fifth. Decreased labor needs in agriculture provided three fourths of the job closings while total employment gains were negligible.

Agriculture remained the leading employment group over the ten year period, even with a one third decrease in total numbers. Employment for this industry was at a much higher rate than for Montana.

Services and finance increased by two percent while the trade group declined by eleven percent. The county lies within the Livingston market area where most goods and services are available. Convenience facilities are available in Big Timber but not of the size or scope necessary to serve the total county.

An analysis of employment characteristics of the trade and the services and finance industry groups further indicates the reliance persons in the county have on other areas for obtaining goods and

CHART 10
Employment Change by Major Industry Group
Sweet Grass County 1950 - 1960



1950 Total Employment 1,495*
1960 Total Employment 1,208*
*Includes Some Industries Not Reported
Source: U. S. Census of Population, 1950-1960

services. One indicator is that almost one third of services and finance labor were in the educational field while less than one in ten of the total group was in professional services.

Percentages for employment by industry group in Table 4 give an insight into local employment characteristics. The table shows the relative weight of each industry group in the county and offers a comparison with that existing in 1960 for the State of Montana and the United States.

The agriculture industry group attracted the largest percent of labor in the county. Just under one half of all employment was included in the group, a rate two and one half times greater than that for Montana and four times that for the United States.

TABLE 4

Percent of Total Employment by Industry Groups

Sweet Grass County, Montana and United States

1960

	<u>Sweet Grass County</u>	<u>Montana</u>	<u>United States</u>
Agriculture	43	17	11
Forestry and			
Fisheries	1	1	1
Mining	1	2	1
Construction	6	7	5
Manufacturing	3	10	27
Transportation			
and Utilities	5	9	7
Service and			
Finance	19	26	16
Government	4	6	13
Trade	18	21	19
Total	<u>100</u>	<u>100</u>	<u>100</u>

Source: U. S. Census of Population, 1960

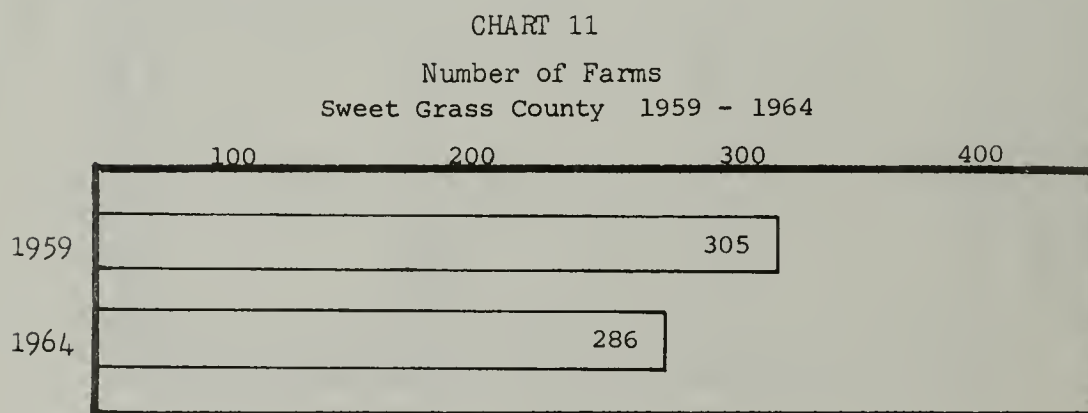
The trade and the services and finance groups were similar to national rates. The total percentages for both groups were, however, somewhat less than those recorded in the state.

Current labor statistics published by the Employment Security Commission of Montana indicate a further decline in employment for 1969. The trade industry group remained constant indicating a strengthening market within the county.

The county will continue to rely upon livestock production for its main economic activity. Since the county is relatively close to feed production areas, livestock feeding operations may become considerably more significant in the future. Growth should be moderate at its highest point.

Agriculture

A farm is defined in the United States Census as a place having at least ten acres of land devoted to agriculture and selling at least fifty dollars worth of agricultural products annually. According to Chart 11, there were 286 farms in Sweet Grass County in the above category in 1964, six percent less than there were in 1959.



Source: U. S. Census of Agriculture, 1964

The 1964 classification of farms by type was as follows:

Field crop farms other than vegetables, nuts, and fruit	6
Cash grain	6
Dairy farms	7
Livestock farms other than poultry and dairy	241
General farms	5
Miscellaneous and unclassified	27
Total	286

Of the total number of farms, eight were classified as part time and sixteen were classified as being operated by semi retired persons.

The average farm in 1964 was 3,183 acres in size and produced livestock. The above data indicates that eighty five percent of all farms were classified as livestock producers. Chart 12 indicates that almost two farms out of every three exceeded one thousand acres in size. Records also point out that about one fifth of all farms were under five hundred acres.

The value of products sold by the number of farms is shown in Chart 13. As indicated, almost half of all farms received over \$10,000 for agricultural products sold while one farm in seven had sales exceeding \$20,000. In 1964 less than one third of all farms reported gross receipts of under \$5,000 for products sold.

Cash receipts data from 1964 to 1967 is as follows:

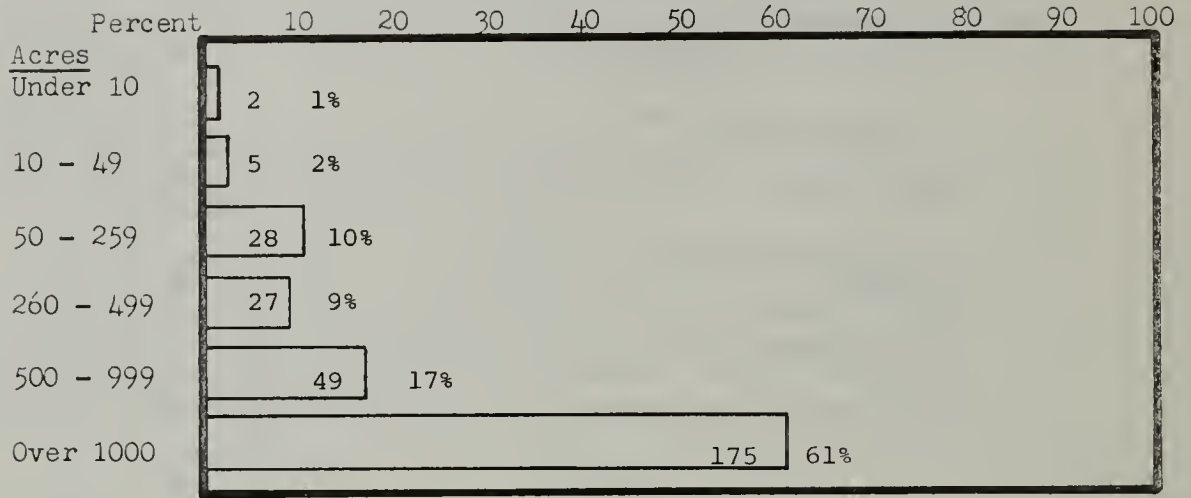
<u>Year</u>	<u>Livestock</u>	<u>Crops</u>	<u>Total</u>
1964	\$3,341,700	\$593,900	\$3,935,600
1965	\$4,068,600	\$628,200	\$4,696,800
1966	\$4,736,800	\$723,100	\$5,459,900
1967	\$3,966,100	\$875,100	\$4,841,200

Agricultural receipts data for the county indicate the importance of livestock production in the industry. Over the four year reporting period income from the sale of livestock accounted for

CHART 12

Farms by Size

Sweet Grass County 1964

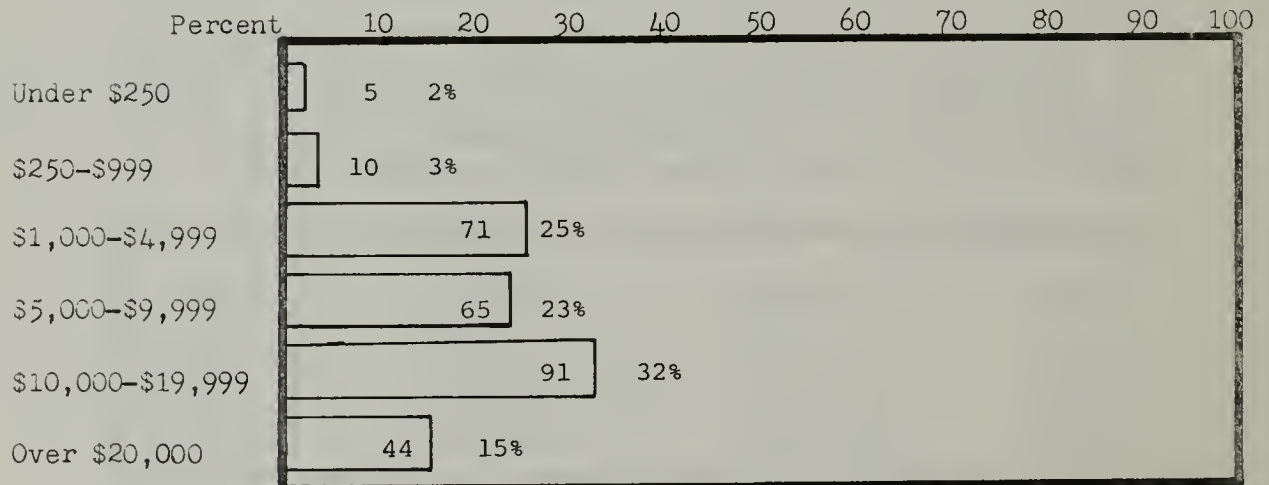


Source: U. S. Census of Agriculture, 1964

CHART 13

Number of Farms by Value of Farm Products Sold

Sweet Grass County 1964



Source: U. S. Census of Agriculture, 1964

eighty to ninety percent of all gross receipts.

The number of farms will decrease because of consolidation over the twenty year period. It is also expected that cattle raising will gain greater frequency in the period.

THE GOVERNMENT

Before any meaningful consideration can be given to major capital improvement projects, it is necessary to study the governmental organizations in Sweet Grass County and to analyze their economic structure. At present there two separate, local governmental units in the county involved within the scope of the water and sewer study. Included are the incorporated city of Big Timber and the government of Sweet Grass County.

A Board of County Commissioners presided over by a chairman governs the county. The incorporated municipality is governed by a mayor council form of government.

In financing capital improvement projects, the incorporated municipality has power to bond and raise the necessary monies for funding projects. The unincorporated small town does not have similar power and, therefore, must rely on financing projects through the county government.

Table 5 indicates the financial condition of each unit of government in 1969.

TABLE 5

Financial Status of County Government and Incorporated Cities

Sweet Grass County 1969*

	<u>Revenue</u>	<u>Expenditures</u>	<u>Assessed Valuation</u>
Sweet Grass County	\$1,579,892.84	\$1,369,398.17	\$20,336,389.00
Big Timber	122,584.06	93,490.97	4,868,377.00

* There are several methods presently available to communities for

financing water and sewer systems:

1. Incorporated Cities and Towns may use Municipal Bonds, Municipal Revenue Bonds, and Special Improvement District Bonds.
2. Unincorporated Towns may use Rural Special Improvement District Bonds and County Water and Sewer District Bonds.
3. Incorporated Cities and Towns and adjacent unincorporated areas may use Metropolitan Sewer District Bonds.

Source: Information received from each governmental unit

THE WATER RESOURCES

General

The water resources of any area are one of its most important assets. Montana is fortunate in that water is in abundant supply over much of the state. This is especially true in the mountain areas and along the major drainages. Water is essential for many human needs with individual consumption and sanitation being foremost. Industrial and agricultural uses of water are perhaps next most important. The recreational use of water has also become a significant factor in modern day living.

In his use of this resource, man in the past has polluted much of the available fresh water and degraded it to the point where it is unfit for many or all uses. Careful planning for the efficient use of water resources can avert inconveniences caused by pollution.

Water resources, therefore, are an important consideration in the comprehensive planning for community water and sewer systems. In the following portion of this report the existing water resources of the planning area will be briefly reviewed. The discussion will be specifically concerned with the occurrence and availability of both surface and ground water. Also important, and included in Appendix I, are the specific laws and policies of the State of Montana concerning surface and ground-water resources. "Water Quality Criteria," "Water Use Classifications," and "Policy Statements" adopted by the State Department of Health are discussed in detail. Table A in Appendix I outlines present day water quality standards as set forth by the United States Health Service.

TABLE 6

Stream Gaging Stations

Stream	Gaging Sta. Location	Drainage Area (sq mi)	No. of Gages	Discharge (cfs)			Years Averaged	Runoff-(1000 Acre-Ft)		
				Max.	Date	Min. Date		Max.	Date	Min. Date
1. Boulder River	Near Contact	226	1	5,100	6/14/11	4.2	20	349	1911	206.4
2. Boulder River	At Big Timber	523	1	9,840	5/28/56	10	19	545.6	1957	330
3. Sweet Grass Creek	Above Melville	563.8	1	2,270	6/17/65	0.7	42	76.2	1950	45.2

Source: U. S. Geological Survey Water Supply Papers and
"Surface Water Records of Montana"

Note: 1. Some irrigation diversions occur above this station

Surface-Water Resources

Sweet Grass County has an extensive drainage system which has characteristics of both plains and mountainous topography. The county has significant mountainous areas in its southern third and also in the northwestern corner. A portion of the Beartooth and Absaroka Ranges occupies the southern third of Sweet Grass County and a portion of the Crazy Mountains occupies the northwestern corner of the county. The mountainous portions of the county are heavily timbered while the Yellowstone River drainage and the northeastern area are the major timber free areas.

The wide variation in elevations add to the complex surface drainage system. Elevations in excess of eleven thousand feet occur in the Crazy Mountains and also in the Absaroka Range in extreme southwestern Sweet Grass County. The lowest elevation in the county occurs where the Yellowstone River enters Stillwater County southeast of Greycliff. The elevation at this point is less than four thousand feet above sea level.

Many streams and rivers make up the complex drainage system of Sweet Grass County. Major streams making up the system are the Yellowstone River, the Boulder River, and Sweet Grass Creek. The Yellowstone River enters Sweet Grass County near Springdale and flows in an easterly direction across the county before entering Stillwater County. The Boulder River heads in the Absaroka Range of extreme southern Sweet Grass County and flows in a northeasterly direction to its confluence with the Yellowstone River at Big Timber. Sweet Grass Creek heads in the Crazy Mountains in northwestern Sweet Grass County and flows in an easterly and southerly direction before joining the Yellowstone River near Greycliff.

The above mentioned streams and their tributaries provide a yearlong source of water for irrigation, livestock, and domestic needs. Many of these streams have gaging stations installed by the United States Geological Survey. Measurements are taken and recorded at regular intervals. Table 6 includes available data on the drainage area, discharge, and runoff for each gaging station pertinent to Sweet Grass County.

Many small reservoirs provide water storage for various uses in Park County. Two reservoirs were constructed along Sweet Grass Creek in north central Sweet Grass County to supplement irrigation facilities for that drainage. The upper reservoir is called Lake Adam and has a capacity of eleven thousand acre feet. The lower reservoir is called Lake Walvoord and it has a capacity of fourteen thousand acre feet. With the aid of diversion canals and other irrigation facilities, these two reservoirs provide service for over eight

thousand acres of irrigated land. Many smaller reservoirs provide water storage for other uses in the county. The Montana Water Resources Board has published a list of information for all dams and reservoirs which store over fifty acre feet of water. Where the information was available, this list also includes data for privately owned dams and reservoirs. This information and other related irrigation facility information can be obtained from the Water Resources Board in Helena.

The climate varies considerably from one area to another because of the wide range of topographic conditions. The effect that the topography has on the climate is very important to the water resources of the county. Prevailing west to southwest winds flowing across the high mountains provide the highest annual precipitation values; whereas, the valley portions of the county experience much lower values. As an example of the net effect of these conditions, a precipitation measuring station at Melville on the plains of northern Sweet Grass County recorded an average annual rainfall figure for 1969 of 13.78 inches. Precipitation measuring station records for Big Timber in central Sweet Grass County indicate yearly precipitation figures just under fifteen inches. Although no official records are available for the mountainous areas of Sweet Grass County, indications are that the mountains of the Crazy, Absaroka, and Beartooth Ranges. receive annual precipitation values in excess of twenty inches.

In general, precipitation occurs as steady rain in the spring months of April through June, intermittent showers throughout the summer and early fall months, and as snowfall in the winter months. The majority of the precipitation in the lower valleys and agricultural areas occurs during the growing season. Precipitation in the mountainous areas is fairly steady throughout the year. Much of the precipitation during the winter months occurs as snowfall, and the resulting heavy snowpack produced in the high mountains each year contributes significantly to the water resources. Snow begins to accumulate in November in the higher mountain valleys and continues to build up until late March or early April. Portions of the high mountain snowpack in Sweet Grass County and in other adjacent drainage areas remain until the warm temperatures of late spring and early summer begin to melt them. The runoff from the snowpack at this time of the year coincides with the period of maximum demand for water in the valleys below.

The use of surface water is widespread for agricultural and recreational purposes. The 1964 Census of Agriculture indicates that over 47,000 acres were being irrigated in Sweet Grass County at that time. As is the case in most counties in Montana, a potential exists for the irrigation of even more acreage. A final but important use of surface water is for recreational purposes. The mountain lakes and streams

in the county are ideal habitat for fish and waterfowl and draw many fishermen and hunters to the area each year.

Water Use Classifications

The Water Pollution Control Council has classified the streams and drainages in Montana according to the water use classification definitions shown in Appendix I. The streams and drainages of Sweet Grass County and surrounding areas are classified as follows:

Missouri River Drainage from Rainbow Dam in Great Falls to the North Dakota line except the tributaries pertinent to Sweet Grass County listed below:	B-D ₃
---	------------------

Musselshell River drainage to and including Hopley Creek near Harlowton	B-D ₁
---	------------------

Musselshell River drainage from Hopley Creek to but excluding Half Breed Creek near Roundup except American Fork listed below:	B-D ₂
--	------------------

American Fork drainage	B-D ₁
------------------------	------------------

Yellowstone River drainage from the Yellowstone Park boundary to the Laurel water supply intake	B-D ₁
---	------------------

Ground-Water Resources

Ground water is widely used in Sweet Grass County for domestic and stock water purposes. As of January 1970, 399 wells and 1,412 spring appropriations were on file at the Montana Bureau of Mines and Geology for Sweet Grass County. The 399 wells are divided into the following water use categories: 158 stock, 143 domestic and stock, eighty nine domestic, four irrigational, two institutional, and one public supply. Of the 1,412 springs, 784 were used for stock, thirty seven for domestic and stock, twenty six for domestic, forty eight for irrigation, five for public supply, and two for commercial; the water use for the remaining 509 was not reported. The town of Big Timber, the only incorporated municipality in Sweet Grass County, obtains its water supply from one well and an infiltration gallery along the Boulder River. (See Table 7 for chemical analyses of these water supplies.) Privately owned wells provide the residents of

Greycliff, McLeod, and Melville with water for household, lawn, and garden needs.

Only one reconnaissance hydrogeological report has been published on the northern part of Sweet Grass County, Gross, S. L., 1962, Reconnaissance ground-water studies, Wheatland, eastern Meagher, and northern Sweet Grass Counties, Montana: Montana Bureau of Mines and Geology Spec. Pub. 24, 31 p. Several other maps and reports containing useful geological information on parts of Sweet Grass County are available.

TABLE 7

Chemical Analysis of Municipal Water Supplies
(All Figures in Milligrams per Liter) *

<u>City or Town</u>	<u>Big Timber</u>	<u>Big Timber</u>
Source	Infiltration Gallery	Well
Date	8/64	2/64
Total Solids	172	154
Hardness	158	150
Ca	43	32
Mg	12	17
Na+K	2	1
CO ₃	0	0
HCO ₃	165	146
SO ₄	22	27
Cl	2	2
NO ₃	0.0	Trace
F	0.4	0
Fe	0.10	0
As	0.00	-
Pb	0.00	-
Cu	0.00	-
Zn	-	-

* See Appendix I, Table A, for accepted water quality standards

Source: State Department of Health, Helena, Montana

The occurrence and availability of ground water in Sweet Grass County are closely related to the geological history of the area. This history involves long periods of sedimentation, structural deformation, emplacement of large igneous masses, erosion, and glaciation. The rocks exposed in Sweet Grass County vary greatly in age, lithology, thickness, and areal distribution.

During Precambrian time (over 600 million years ago), thousands of feet of sediments were deposited and then altered by heat and pressure to form metamorphic rocks, predominantly gneiss and schist. These were later uplifted, faulted, folded, intruded by igneous material, and eroded during Precambrian time. Following this extensive period of erosion, another thick sequence of sediments (sandstone, shale, and limestone) were deposited over the entire region during Paleozoic (225 to 600 million years ago) and Mesozoic (65 to 225 million years ago) times. At the end of the Mesozoic Era the entire region including all of Sweet Grass County was again uplifted, faulted, folded, and eroded. The largest amount of uplift and deformation occurred in the northern part of the county forming the Beartooth and Absaroka Mountains. The sedimentary rocks covering the northern part of the county tilt or dip gently to the northeast. The emplacement of large masses of igneous material (volcanic and plutonic rocks) started at the end of Mesozoic time and continued into Tertiary time (one to 65 million years ago) forming the Crazy Mountains and covering the southeastern part of the county with volcanic rocks. During Tertiary time (one to 65 million years ago) forming the Crazy Mountains and covering the southeastern part of the county with volcanic rocks. During Tertiary time erosional debris derived from these igneous rocks and from the high mountain areas to the south was deposited in the Crazy Mountain Basin (covering the northern part of the county) producing the Livingston and Fort Union Formations. During Pleistocene time (twenty thousand to one million years ago), the Beartooth, Absaroka, and Crazy Mountains continued to erode and were extensively glaciated. Recent (less than twenty thousand years ago) geological activity includes continued erosion of the upland areas and deposition of sediments along the major streams in Sweet Grass County.

Most of the ground water in Sweet Grass County is derived from the following aquifers (water bearing strata): (1) metamorphic rocks of Precambrian age; (2) sedimentary rocks of Paleozoic age; (3) Kootenai, Eagle, Judith River, Lennep, and Hell Creek Formations of Cretaceous age (65 to 135 million years old); (4) Livingston Formation of Cretaceous and Tertiary age; (5) Fort Union Formation of Tertiary age; (6) terrace and outwash deposits of Pleistocene age; and (7) alluvial flood plain deposits of Recent age.

A thick sequence of Precambrian metamorphic rocks, mostly gneiss and schist, are exposed in the southern portion of the county. These rocks are tightly compacted and have very low porosity and permeability (ability to store and transmit water); consequently, only small quantities of water (one to three gallons per minute (gpm)) can be expected from wells penetrating these rocks. Somewhat larger yields can be expected if extensive fractured and/or weathered zones can be encountered. The water is usually excellent in quality. Precipitation is the major source of recharge to the Precambrian rocks.

Paleozoic rocks outcrop along the flanks of the Beartooth and Absaroka Mountains and underlie the northern three quarters of the county. Potential water producing formations are the Flathead Sandstone, Madison Limestone, and Quadrant Sandstone. These formations are the source of numerous springs in the mountains and foothills in the southern part of the county where they are close to the surface. In the northern two thirds of the county the Paleozoic sediments are too deeply buried to be considered as potential aquifers. These sediments are recharged mostly by precipitation and by streams crossing the outcrop areas.

A number of Cretaceous sandstones underlying the northern two thirds of the county are good water bearing formations, and they are potential aquifers wherever they occur within five hundred feet of the surface. Small to moderate quantities of water (two to fifteen gpm) can usually be obtained from the sandstone lenses in the Kootenai, Eagle, Judith River, Lennep, and Hell Creek Formations.

Water derived from these sandstone units is somewhat mineralized but generally suitable for domestic and stock uses.

Overlying the Hell Creek Formation and covering the northeastern one third of the county is the Fort Union Formation. Wherever the formation has not been eroded, it attains a thickness of about two thousand feet. The Fort Union is composed of three members, upper Tongue River Member, middle Lebo Member, and lower Tullock Member. Sandstone lenses and associated coal seams in the Tongue River and Tullock Members will commonly yield small amounts of water (one to ten gpm) generally suitable for domestic and stock purposes. The Lebo Shale is mostly shale and is not an aquifer.

Underlying the northwestern one third of the county is the Livingston Formation. It is both Cretaceous and Tertiary in age and consists of assorted volcanic material including grit, sandstone, shale, and agglomerate. The Livingston is up to fifteen thousand feet thick, and its water yielding characteristics are largely unknown. The Livingston Formation is the source of numerous springs in the area.

Infiltration of precipitation and streams is the source of recharge to all the sedimentary rocks of Cretaceous and Tertiary age.

Many high mountain valleys have a thin mantle of glacial material. These sediments include stratified material forming outwash deposits and terrace gravels, as well as unsorted clay, silt, sand, and gravel debris commonly called glacial till. The unsorted material yields very little water to wells; however, the stratified outwash deposits and low level terrace gravels frequently make good aquifers capable of producing small to moderate quantities (ten to two hundred gpm) of water to wells. The water derived from these materials is usually good to excellent in quality.

The most widely used, dependable, and productive aquifer in Sweet Grass County is alluvial flood plain material of Recent age present along all the major streams (Yellowstone and Boulder Rivers and Big Timber and Sweet Grass Creeks) and tributaries. In general, wells will yield moderate to large amounts (ten to five hundred gpm) of water. Water derived from alluvial deposits is generally excellent in quality, but it can be contaminated by seepage of surface water. The unconsolidated sediments of Pleistocene and Recent age are primarily recharged by nearby streams and irrigation water.

In summary, there has been little development of ground water contained in the bedrock formations underlying Sweet Grass County. These bedrock aquifers are capable of supplying small quantities of water to hundreds of additional wells. The unconsolidated Pleistocene and Recent age materials are the only aquifers in the county capable of producing moderate to large quantities of ground water for irrigation, industrial, and municipal purposes. Detailed hydrogeological studies are needed to assist in future development of Sweet Grass County's ground-water resources.

- Sources:
1. M. K. Botz, Montana Bureau of Mines and Geology, Butte, Montana, 1970
 2. State Department of Health, Helena, Montana
 3. U. S. G. S. Water Supply Papers and "Surface Water Records of Montana"
 4. Weather Bureau, Climatological Data, Montana Section, 1969.

THE SOILS

General

General descriptions of soils in specific areas are useful in predicting the potential problems which might be encountered during private and public works construction. Sweet Grass County has an interesting and complicated geologic history which has greatly influenced the soil structure of the area. The dominating physiographic features are the broad Yellowstone River drainage, the Crazy Mountains, the Beartooth Mountains, and the Absaroka Range.

The soils of Sweet Grass County were derived from parent materials originally located in the valleys and adjacent mountains. The parent materials, which include both igneous and sedimentary rock formations, were eroded, transported, and deposited by various processes, and thus the soils resulting consist of stream deposits or alluvium and the alterations of the parent materials due to various conditions of climate, topography, and living organisms.

Soil Map

The Soil Conservation Service of the United States Department of Agriculture is currently engaged in a soil survey for Sweet Grass County. A general soil map for the county is being prepared from this study, but at this time the map is not ready to be published. Detailed information concerning specific areas in the county can be obtained from soil scientists working in the area. The soil scientists should be contacted at the Big Timber Soil Conservation Service office for soil information in areas where projects are planned to be constructed.

A publication entitled "Soils of Sweet Grass County," issued in May 1956, is available from the Agricultural Experiment Station in Bozeman, Montana. This bulletin is part of a soil reconnaissance of Montana counties completed by L. F. Gieseke in cooperation with the United States Department of Agriculture. The bulletin contains very little interpretive information in regard to the engineering properties of soils, but it does provide a preliminary general soil map with brief soil descriptions. The map revised somewhat for clarity following reduction of scale is shown in this report as Map 4. The soil descriptions give a general idea of existing conditions in Sweet Grass County, and it must be realized that this information is only preliminary to the more detailed study currently being conducted. It is recommended that all available data be utilized in the planning

of public works projects and, in addition, on site soil investigations for specific projects should be performed.

Brief descriptions of the general soil areas shown on the map are as follows:

1. Absarokee Soils. The Absarokee soils have developed on thinly interbedded, indurated arkosic sandstones and shales of the Tullock and Hell Creek formations. They occupy high plateau remnants bordering the Beartooth Mountains in the southern part of the county. The soils of this series are characterized by moderately dark, surface soils and heavy subsoils overlying thinly interbedded shales and fine grained sandstones.

2. Bainville Soils. The soils of the Bainville series have developed largely from more or less indurated, calcareous, silty shales, siltstones, and fine grained sandstones of the Tongue River, Lebo, and Tullock geologic formations. These soils have silt loam to clay loam subsoils grading into altered bedrock with depth. They cover eroding ridges, hills, and stream breaks north of the Yellowstone River. These soils being thin and immature differ little from the slightly weathered parent material in which they are developing.

3. Big Timber Soils. The soils of the Big Timber series are characterized by moderately dark surface soils and heavy clay loam subsoils. They are underlain at comparatively shallow depths with slightly altered, thinly to thickly bedded or stratified volcanic conglomerates and mud flows of the Livingston formation. They occupy dissected uplands below the Crazy, Absaroka, and Beartooth Mountains.

4. Mountains-Timbered. Timbered mountains are found mainly in the higher and more humid sections of the Absaroka and Crazy Mountains where conditions are favorable for timber growth. A fair portion of the area consists of rock outcrops, rock slides, rock walled canyons, and barren mountain peaks. The soils developed under a dense timber cover are as varied and have as distinctive physical and morphological features as those developed under a grass cover. Timbered mountains cover 538 square miles of Sweet Grass County.

5. Williams-Barnes Soils. The soils developed from till in the upper Boulder River Basin and along American Fork and other streams heading in the Crazy Mountains are grouped in the Williams and Barnes series. These soils occupy morainic tracts, which are utilized for the grazing of livestock. The Williams soils are dark brown and the Barnes are nearly black soils. Only stony types occur in the county.

6. Alluvial Soils-Undifferentiated. The undifferentiated alluvial soils occur chiefly on flood plains and high bottom lands in such stream valleys as those of the Yellowstone and Boulder Rivers and their branches. The textural range of these soils is wide, and the content of soluble salts and lime varies with location in reference to the mountains and high divide. Surface and subsurface drainage differ greatly, depending upon the slopes, the soil texture, and the position or elevation of the soil in relation to the stream channel. In the mountain and foothill sections where the rainfall is greater, the alluvial soils are darker colored and usually have a fair amount of stone and gravel in the soil profile.

7. Travessilla-Terry Soils. The soils of the Travessilla and Terry series have formed on indurated, fine grained sandstones of such geologic formations as the Tongue River and Tullock. The Travessilla soils are shallow, stony Lithosols occurring respectively in the dark brown and brown soil zones. The soils of the Terry series are normal brown soils moderately deep over bedrock. The Travessilla and Terry soils are associated on local divides north of Big Timber Creek.

8. Cushman Soils. The Cushman soils are associated with the Bainville soils described in item number two; the Cushman soils, however, have thicker and more developed surface and subsoils and a greater depth of weathered parent material than the Bainville soils. They cover large tracts in the north central part and isolated tracts in the central part of the county north of the Yellowstone River where the topography is smoother.

9. French Creek Soils. Immature to semimature soils developing in colluvial-alluvial material or slope wash on valley slopes occur throughout the county. The soils on the slopes below the gravel capped tablelands were undifferentiated and are grouped in the French Creek series.

10. Fairfield Soils. The soils on the older and higher benches and tablelands are placed in the Martinsdale, Fairfield, and Croff series. The soils of these three series have developed on ancient gravelly outwash deposits in which the space between the gravel and cobbles is filled with limy fine earth to a depth of three or four feet. The dark brown Fairfield soils occupy the high tablelands along the stream valleys in the central and northwestern parts of the county.

11. Renohill Soils. The soils of the Renohill series have developed mainly on the more thinly interbedded shales, silty shales, and fine grained sandstones of the Lebo and Tullock formations in the northern part of the county. The subsoils are massive or blocky

heavy clay loams to friable clays. They occur chiefly in the central part of the county north of the Yellowstone River. The Renohill soils are brown soils occupying rolling uplands on the divide west of Sweet Grass Creek.

12. Lismas Soils. The Lismas soils are formed on indurated, volcanic mud flows occurring in the central part of the county. These Lithosolic soils, suitable only for the grazing of livestock, are described as clay loam.

13. Manvel Soils. The Manvel soils are associated with the French Creek soils described in item nine. The soils belonging to the Manvel series, however, occur in the northern and central parts of the county where the material is largely of silty to clay texture.

14. Martinsdale Soils. As described in item ten, Martinsdale soils are associated with the Fairfield and Croffs series. The brown Martinsdale soils, however, occupy benchlands along Sweet Grass Creek in the vicinity of Melville. They are described as clay loam and cobbly clay loam.

15. Midway Soils. The Midway soils are associated with the Renohill soils described in item eleven. The Midway soils differ in that they are Lithosols underlain at shallow depths with slightly altered bedrock. They occur on sharp ridges and knolls and steep slopes. The soils of the two series are utilized chiefly for the grazing of livestock and are generally described as clay loams.

Conclusions

The soils of Sweet Grass County have generally been easy to deal with where domestic water wells and individual sewage drainfields have been constructed. The alluvium and other soil deposits have been found to be extremely variable in permeability, however. This has had an effect on both the quantity of water available in shallow domestic wells and the successful operation of individual sewage drainfields. Some areas of extensive clay and silt deposits require special care in the construction and operation of septic tank drainfields. Also, the presence of a high ground-water table in many valley bottoms and stream drainages causes poor subsurface drainage conditions.

Construction of municipal water and sewer systems in the various soils of Sweet Grass County has not been found to be difficult. Pipeline trench digging in the sands and clays is extremely easy while the coarse gravels slow operations somewhat. Bedrock at shallow depths is not common in the valley bottoms; however, it can be expected at normal water and sewer line installation depths at specific isolated

spots near the toe of mountain slopes. Detailed soil information should be obtained before project planning and construction cost estimating are begun.

- Sources:
1. "Soils of Sweet Grass County," L. F. Giesecker, Montana State College Agriculture Experiment Station, Bozeman, Montana, May, 1956
 2. U. S. Department of Agriculture, Soil Conservation Service, Big Timber, Montana

COMMUNITY WATER SYSTEM FACILITIES

General

This comprehensive report covers the overall problems, existing or projected, for Sweet Grass County, Montana. The volume of data processed and evaluated and the intent of the report allow only a general analysis of any one system.

The intent of this report is to point out the general needs of each community with the objective that each community may in the future be provided with a safe and adequate water system. The general solutions to overall problems suggested in this report may have to be modified when detailed studies are made. These modifications may be in exact size of parts of a system or in some detailed design variation but will not detract from the overall value of the general information presented.

Basically, the demand for water from community systems is for domestic, fire fighting, and industrial uses. The demand for industrial water supply in small communities has not been extensive in Montana and in most cases will not control the design of community systems. Sufficient water for fire fighting must be considered; however, economic feasibility will usually control the extent of such facilities. In most small communities a system with sufficient capacity to give high ratings for fire protection would require facilities considerably larger than necessary for domestic purposes. The community might be unable to finance such an improvement; the approach, therefore, has been to propose a system suitable for present domestic needs. These basic facilities can be expanded for more complete service and for higher fire ratings as it becomes economically feasible.

The domestic use of water has increased greatly in recent years. This is partially due to improved economic conditions which make it

possible for families to acquire such water consuming appliances as dishwashers, waste disposal units, and automatic washing machines. Water use for beautifying property has also increased. The most essential condition is adequate, safe, and potable water for domestic purposes, and this has been the primary consideration in this study. Appendix II contains further information on analysis criteria.

Basic Considerations

Communities studied in this comprehensive plan were those with a minimum of five potential users and a maximum population of 5,500. Each community within this category was visited at least once. During these visits the type of water facilities available was examined, and an evaluation of the facilities was made from the standpoint of fulfilling the needs of the residents.

The existing systems were found to be quite varied in their operation, condition, and suitability for serving the needs of the users. The situation in each community was evaluated separately; however, some general classification of the various systems was possible. These are described briefly in the following paragraphs so that the general philosophy of the analysis can be shown.

1. In some communities the homes are quite widespread and few in number. Good water in adequate quantities can be at reasonable depths, and for such situations private wells will provide a safe and suitable water system.

2. Many communities have had access to good water from private wells for many years. In some of these communities population is increasing, and the area is becoming more densely settled. As a result, tests for bacteriological quality of well water occasionally indicate that pollution is present. When this occurs, it is usually the beginning of a problem which will continue to worsen. Increasing population and a higher potential for contamination indicate the need for a safe community water facility. The system should be one which will serve the domestic needs of the present residents with provisions for improvements and expansion as needed.

3. Many communities have enjoyed a central water system for years but have not made annual improvements and replacements. This has resulted in overloaded and antiquated systems. Suggestions for immediate improvements which will fit into an overall replacement program are included in this report.

4. Some communities which have experienced a steady

population growth are finding that their water systems are inadequate for present demands and will require enlargement. Population projections and economic trends are used to determine the need for improvements and also to justify the type and extent of proposed improvements.

Sweet Grass County

The estimated 1970 population of Sweet Grass County is 2,900. Approximately 1,750, or sixty percent of these people, are presently served by central water systems, and the remainder are served by such facilities as wells and springs. By 1980 about 1,850, or sixty nine percent of the population, will have access to central water systems if the schedule of proposed improvements is followed. It is expected that the remaining twenty one percent will live in outlying areas, and the homes will not be close enough together to make central systems feasible.

Big Timber

Existing System. The estimated 1970 population is 1,750. Population projections indicate that the town will show substantial increase throughout the planning period. The town is served by a central water system, and the layout is shown on Map 5.

Water supply is obtained from the Boulder River at two locations. An infiltration gallery with pumping facilities capable of producing 610 gallons per minute (gpm) is located just south of the town. The actual amount of water which can be pumped from this gallery is not exactly known; however, it is less than the pumping capacity. The infiltration gallery was constructed many years ago and does need improvements. Presently water does not flow into the gallery at a fast enough rate. The main supply of water is obtained from two infiltration galleries located about five and one half miles above the town. A fourteen inch steel supply line carries water directly from one of the infiltration galleries to the distribution system. The amount of water available from this supply line is not exactly known. Water from the second infiltration gallery is transmitted through a sixteen inch gravity line to a storage reservoir located about two and one half miles south of town. From this storage reservoir the water is transmitted through a twelve inch line to a point where it connects with the fourteen inch supply line. The combined flow then continues on to the distribution system. The exact quantity of water available from this source is not known; however, when combined with the infiltration gallery located at the townsite sufficient water is available for normal demand periods. Water shortage is experienced during high demand periods of the summer.

Storage presently consists of a 325,000 gallon open reservoir located two and one half miles south of the town. This is sufficient storage for the present and future populations of the town. It would be desirable to have high service storage located in the town itself. This would tend to alleviate water shortages which are presently experienced during the summer months. The distribution system consists of four, six, eight, twelve, and fourteen inch diameter water mains. There are many dead end lines throughout the system which cause low pressure during high demand periods. The distribution piping is reportedly in good condition.

Improvements Next Five to Ten Years. By 1975 the population is expected to be eighteen hundred. Additional water supply is needed at the present time, and the demand will continue throughout the planning period. The existing infiltration gallery located just south of town should be enlarged so that the entire pumping capacity of the facility can be utilized. An additional infiltration gallery with a capacity of two hundred gpm could be developed as shown on Map 5. This would result in an adequate quantity of water being available throughout the planning period. Additional water supply could also be obtained by constructing a new supply line to the existing storage facility two and one half miles south of town. Under the present setup, the water available from this storage tank and from the fourteen inch supply line must travel the final two and one half miles to town through one fourteen inch diameter supply line. By installing the new eight inch line head, losses would be reduced and sufficient water would reach the distribution system.

A storage facility with a capacity of 200,000 gallons would be a desirable improvement to the system. By constructing this facility near the center of town, more uniform pressures would prevail. Many of the dead end lines should be tied into a circumferential loop of six inch water main. This will also tend to alleviate reduced pressures during high demand periods.

The existing fourteen inch supply line to the infiltration galleries five miles south of town has been in place for about thirty five years. There have been problems associated with pipe deterioration apparent on this supply line. It is anticipated that sections of this line will have to be replaced during the next twenty years. This could be accomplished on an as needed basis.

Improvements by 1990. For 1990 the population is estimated to be nineteen hundred. The existing system together with the improvements proposed under the five to ten year plan will provide a facility which will adequately serve the needs. Minor repair and replacement will be necessary throughout the entire planning period.

Greycliff

Existing System. The thirty five persons who presently reside in this community obtain their water supply from private wells. The quality of this water is good; however, it is classified as hard. There are adequate quantities of water available for each household. The wells range in depth from twenty to fifty feet and do not present any major operational problems.

Improvements by 1990. For 1990 the population is expected to be twenty. The present use of private wells provides an adequate quantity of good quality water to each household. Throughout the entire planning period the present use of these facilities will continue to be the most suitable means for obtaining water supply.

Melville

Existing System. The fifteen persons who presently reside in this community obtain their water supply from private wells. The quality of water is good and the quantity available adequate for each household. These wells are about twenty five to fifty feet in depth and do not present operational problems.

Improvements by 1990. For 1990 the population is expected to be ten. Throughout the entire planning period the present use of private wells will continue to be the most suitable means for obtaining a water supply for this community.

McCleod

Existing System. The ten persons who reside in this community rely on private wells for water supply. The quality of this water is reportedly excellent and the quantity available adequate for each household. These wells are from twenty to forty feet in depth and do not present operational problems.

Improvements by 1990. For 1990 the population is expected to be ten. Throughout the entire planning period the present use of private wells will continue to be the most suitable means of obtaining water supply.

COMMUNITY SEWER SYSTEM FACILITIES

General

Each use of water adds some material or alters some characteristic

enough to change the original quality of the water and often to pollute it. The transportation and dilution of municipal, industrial, and agricultural wastes are important and necessary uses of water; therefore, special emphasis is placed on the control of water pollution from these sources. Some of these wastes can be carried in limited amounts without damage to the resource. Some wastes if discharged into water courses can make their way into underground aquifers and pollute the ground water so that it is unsuitable for further use.

Pollution by definition and interpretation is a matter of degree. Since it is inevitable that the quality of water will be altered with each use, it is of critical importance to control the degree of pollution.

It is public policy established by the state legislature to maintain reasonable standards of purity for the water of the state. These standards are to be consistent with the use of these waters, including their use in carrying away the water borne waste products of society. The current Federal Water Pollution Control Act in reference to pollution abatement gives the individual states discretion in assessing the physical and economic feasibility of complying with water quality standards. The "Water Quality Criteria," "Water Use Classifications," and "Policy Statements" of the Montana Water Pollution Control Council for streams and rivers in Montana have been included in Appendix I.

Sewage may be broadly categorized as domestic or municipal waste, industrial waste, and animal or agricultural waste. Animal wastes are usually not involved in community sewage facilities; however, they do constitute a potential source of pollution which must be controlled and prevented from entering streams or other potential water supplies.

Although industrial activity throughout Montana has been limited, the need for control and treatment of industrial wastes is apparent. Industrial wastes vary in quantity and composition as greatly as the products and processes which generate them. They include toxic chemicals, solids carried in suspension, brines, strong acids and alkalies, oils, dyes, floating solids, and the heat generated by industrial processes. Industrial wastes are not found to be a major factor in the design of most community sewage facilities. Where economic projections indicate industrial development, the relationship to loading on domestic sewer systems is considered.

Domestic sewage is the primary consideration of this study and has been the basis for design and analysis. Where particular systems are subjected to loading from industrial sources, a more detailed study will be necessary. The general approaches outlined in "Analysis

Criteria" in Appendix III will suffice in practically all cases.

Basic Considerations

There are generally three main methods of sewage disposal. These are septic tanks, mechanical sewage treatment plants, and wastewater stabilization ponds. Local soil conditions, availability of land, and density of population are the basic factors which govern the selection of a particular method.

Many of the smaller communities have relied on individual septic tanks and cesspools for each home to handle sewage disposal. Septic tanks are suitable if the population density is low and if the systems are properly designed and maintained. Overflow from these tanks must drain into the soil and, depending on local soil conditions, may or may not create a problem. There is a limit to the amount of water that even loose granular soil can absorb. Density of population and the length of time the effluent has been entering the soil are factors which indicate whether septic tanks can be suitable for sewage disposal.

When economically feasible, community sewage collection and disposal systems are much more desirable than individual systems. Community systems eliminate the worry of septic tank failure, the danger of well contamination, and the problem of soil saturation. However, it is usually uneconomical to serve a few homes scattered over a large area with a community sewer system.

The type of sewage disposal facilities to be used can generally be determined on the basis of economic factors. Mechanical treatment plants provide an excellent means of sewage disposal although the initial cost, maintenance cost, and power cost are usually high. Wastewater stabilization ponds are an ideal method of sewage disposal and usually are the most economical to construct and maintain.

The Montana Water Pollution Control Council has established the criteria that treatment of domestic and industrial wastes shall be secondary treatment or its equivalent. For domestic sewage, mechanical treatment plants or stabilization ponds, when either is properly designed, constructed, and operated, meet these requirements.

A schedule for completion of secondary treatment facilities by communities across the state has been established by the State Department of Health. The target date is included for individual towns when applicable.

Sweet Grass County

Approximately 1,750, or sixty percent of the Sweet Grass County population, are presently served by community sewage facilities. By 1990 about nineteen hundred, or eighty percent of the population, will have access to community facilities if the proposed expansion program is followed. The remaining twenty percent will live in outlying areas, and the homes will not be close enough together to make community systems feasible.

Big Timber

Existing System. The present population is estimated to be 1,750. A community sewer system is in existence, and the system layout is shown on Map 9.

A collection system consisting of eight, ten, and twelve inch sewer mains picks up sewage and carries it to a collection point near the east edge of town. This collection system has adequate capacity for present and future populations. There is some infiltration presently getting into the system; however, it is not considered to be a problem. A twelve inch outfall line continues on to the treatment facilities. This outfall line has sufficient capacity for present and future sewage flows. Sewage treatment presently consists of an eighteen acre wastewater stabilization pond. This facility has sufficient capacity for the present and future needs of the town.

Improvements Next Five to Ten Years. The estimated 1975 population is eighteen hundred. The present sewage collection and disposal system has sufficient capacity for the needs of this population. The only improvements which are believed to be necessary are extending the collection system to new areas of development. On the north side of the railroad tracks, there is considerable development which does not have access to the community sewer system. It is proposed that service be provided to this area as shown on Map 9. Minor repair and replacement will be necessary during this period.

Improvements by 1990. For 1990 the population is expected to be nineteen hundred. The existing collection system, outfall line, and treatment facilities will have adequate capacity for the needs of this population.

Greycliff

Existing System. The present population for Greycliff is estimated to be ninety five. Sewage disposal is presently handled by private

septic tanks or cesspools. The soil in the area is a loam topsoil underlain by porous gravel. There are no operational problems experienced with these systems since drainage for septic tank effluent is good. Maintenance consists only of occasional pumping. The possibility exists that septic tank effluent could reach the shallower private wells. Wells should be tested for bacteriological content periodically to determine if this is occurring.

Improvements by 1990. For 1990 the population is expected to be twenty. Throughout the entire planning period the present use of private septic tanks will be the most feasible method for disposing of domestic sewage. The systems presently in existence do provide adequate sewage treatment for the wastes from each household.

Melville

Existing System. The fifteen persons who presently reside in this community use private septic tanks and cesspools for sewage disposal. There are no major operational problems experienced with these facilities because the soil in the area has good drainage properties. It is a loam topsoil underlain by porous gravel. It is possible for septic tank effluent to reach the rather shallow, private wells. Bacteriological tests should be conducted periodically to determine if this is occurring.

Improvements by 1990. For 1990 the population is expected to be ten. The present use of private septic tanks will be the most suitable means for sewage disposal throughout the entire planning period. These systems do handle disposal of domestic wastes satisfactorily.

McCleod

Existing System. The ten persons who presently reside in this community rely on private septic tanks and cesspools for sewage disposal. The soil is a sandy loam topsoil underlain by porous gravel. This soil has good drainage properties and readily accepts septic tank effluent.

Improvements by 1990. For 1990 the population is expected to be ten. The present use of private septic tanks will be a suitable means for sewage disposal throughout the entire planning period. It is possible for sewage effluent to reach the rather shallow wells in the area. Periodic bacteriological testing should be conducted to determine if this is occurring.

PREFACE TO MAPS

The following maps have been prepared from several sources. The county maps were prepared from Transverse Mercator Projection Series Maps and Montana Highway Department Maps, Planning and Survey Series. The reduction of the county maps necessary for this publication makes them useful for general reference purposes only.

The town and community base maps used herein are taken from Montana State Highway Commission City and Town Plats prepared from aerial photographs dated 1961 to 1969 and have been updated where necessary. On-site surveys, plats obtained from individual towns, and aerial photography conducted in 1970 were also used. Uncontrolled mosaics have been used and scales are, accordingly, only approximate and are shown for referencing purposes only. The mapping operation was supplemented by field checks made during 1970.

Land use information was obtained by field surveys, supplemented and checked by aerial photography during 1969 and 1970.

Water and sewer systems maps show existing facilities for individual towns and communities except where the information was not available. Data concerning these community facilities was obtained from the records of the individual communities and of the State Department of Health. Water and sewer lines are shown in the center of streets to indicate the existence of lines rather than precise locations. The sizes of lines, obtained from the most current information available, are indicated when possible. The locations of recommended improvements are given as relative locations and are not meant to be scaled from the individual town or community maps.

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MAP I

COUNTY MAP
GENERAL RELIEF

LEGEND

● CITIES-TOWNS

○ COUNTY SEAT

ROADS-HIGHWAYS
 STATE HIGHWAY U. S. HIGHWAY

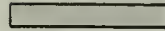
 RAILROADS

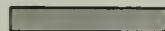
 STREAMS-LAKES

 COUNTY BOUNDARY

 INDIAN RESERVATION

 0-3,000 FT. ELEVATION

 3-5,000 FT. ELEVATION

 5-7,000 FT. ELEVATION

 OVER 7,000 FT. ELEVATION

MAP 2

LEGEND

MAJOR STATE-WIDE COVERAGE

POWER AND GAS SYSTEMS

-  POWER PLANT (IN MEGAWATTS)
-  1 to 50 KILOVOLTS
-  51 to 100 KILOVOLTS
-  101+ KILOVOLTS
-  PROPOSED LINES
-  GAS LINES

RECREATION AREAS

1. LOST CREEK STATE PARK
 2. LEWIS AND CLARK CAVERNS STATE PARK
 3. LAKE MARY RONAN STATE PARK
 4. MEDICINE ROCKS STATE PARK
 5. ROSEBUD STATE PARK
 6. ROCK CREEK STATE PARK
 7. MAKOSHIKA STATE PARK
 8. WEST SHORE STATE PARK
 9. WOODS BAY STATE PARK
 10. BITTERROOT LAKE STATE PARK
 11. ASHLEY LAKE STATE PARK
 12. LONE PINE STATE PARK
 13. JAMES KIPP STATE PARK
 14. HOOPER MEMORIAL STATE PARK
 15. HELL CREEK STATE PARK
 16. FINLEY POINT STATE PARK
 17. ELMO STATE PARK
 18. FLATHEAD LAKE STATE PARK
 19. YELLOW BAY STATE PARK
 20. WALSTAD MEMORIAL PARK
 21. THOMPSON FALLS STATE PARK
 22. WHITEFISH LAKE STATE PARK
 23. WAYFARERS RECREATION AREA
 24. TIBER RESERVOIR RECREATION AREA
 25. CLARK CANYON RESERVOIR RECREATION AREA
 26. ENNIS RECREATION AREA
 27. DEADMAN'S BASIN RESERVOIR RECREATION AREA
 28. PAINTED ROCKS RESERVOIR RECREATION AREA
 29. CANYON FERRY RECREATION AREA
 30. LOGAN PARK RECREATION AREA
 31. NELSON RESERVOIR RECREATION AREA
 32. BEAVERTAIL HILL RECREATION AREA
 33. GLACIER NATIONAL PARK
 34. YELLOWSTONE NATIONAL PARK
-  NATIONAL FORESTS

MAP 3

COUNTY MAP LAND OWNERSHIP

LEGEND

● CITIES-TOWNS

○ COUNTY SEAT

ROADS-HIGHWAYS

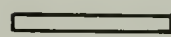
———— STATE HIGHWAY U. S. HIGHWAY

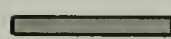
— — — — RAILROADS

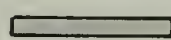
 STREAMS-LAKES

— COUNTY BOUNDARY

 INDIAN RESERVATION

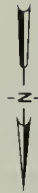
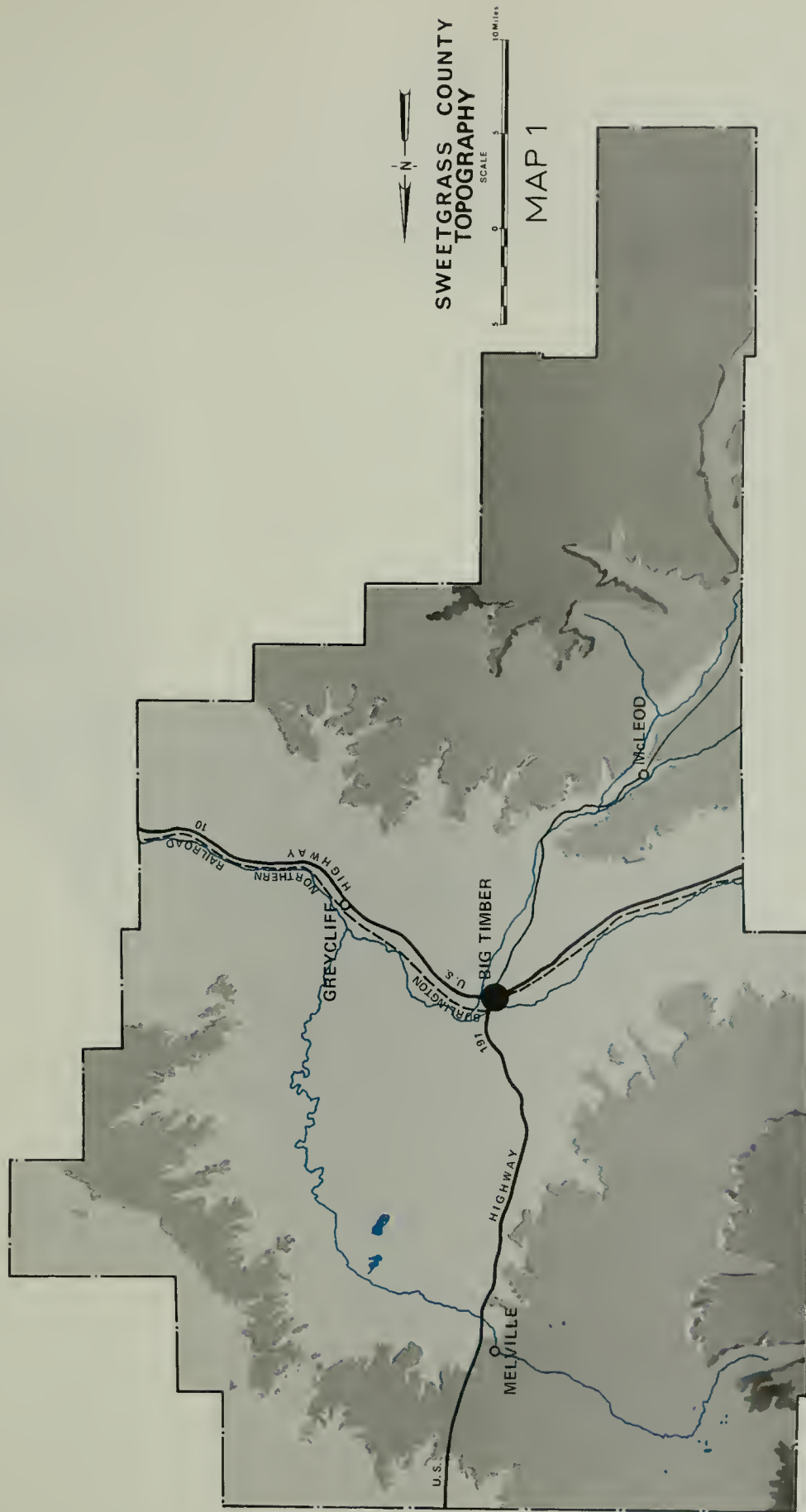
 PRIVATELY OWNED LAND

 STATE OWNED LAND

 FEDERAL OWNED LAND

CITIES MAP LEGEND

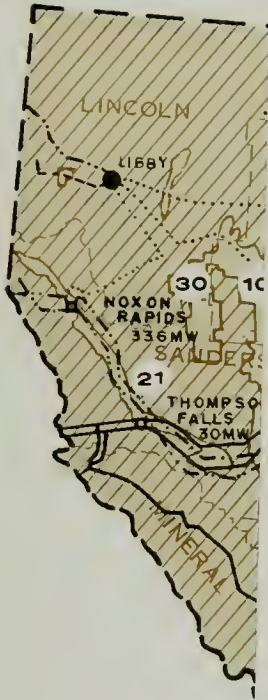
LAND USE	WATER and SEWER SYSTEMS
 SINGLE RESIDENCE	 EXISTING LINES AND SIZES
 DILAPIDATED RESIDENCE	 PROPOSED LINES 5-10 YEAR
 SINGLE TRAILER RESIDENCE	 PROPOSED LINES 10-20 YEAR
 MULTIPLE RESIDENCE	 EXISTING LIFT STATION
 APARTMENTS	 PROPOSED LIFT STATION
 TRAILER COURT	 EXISTING WATER STORAGE TANK
 COMMERCIAL BUILDING	 PROPOSED WATER STORAGE TANK
 HOTEL-MOTEL	 EXISTING WATER SOURCE
 PUBLIC BUILDING	 PROPOSED WATER SOURCE
 SCHOOL	 EXISTING TREATMENT FACILITIES
 CHURCH	 PROPOSED TREATMENT FACILITIES
 HOSPITAL	 SERVICE AREA 1970-1980
 INDUSTRIAL	 SERVICE AREA BY 1990
 GRAIN ELEVATOR	



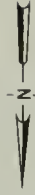
SWEETGRASS COUNTY
TOPOGRAPHY



MAP 1



MAP 2

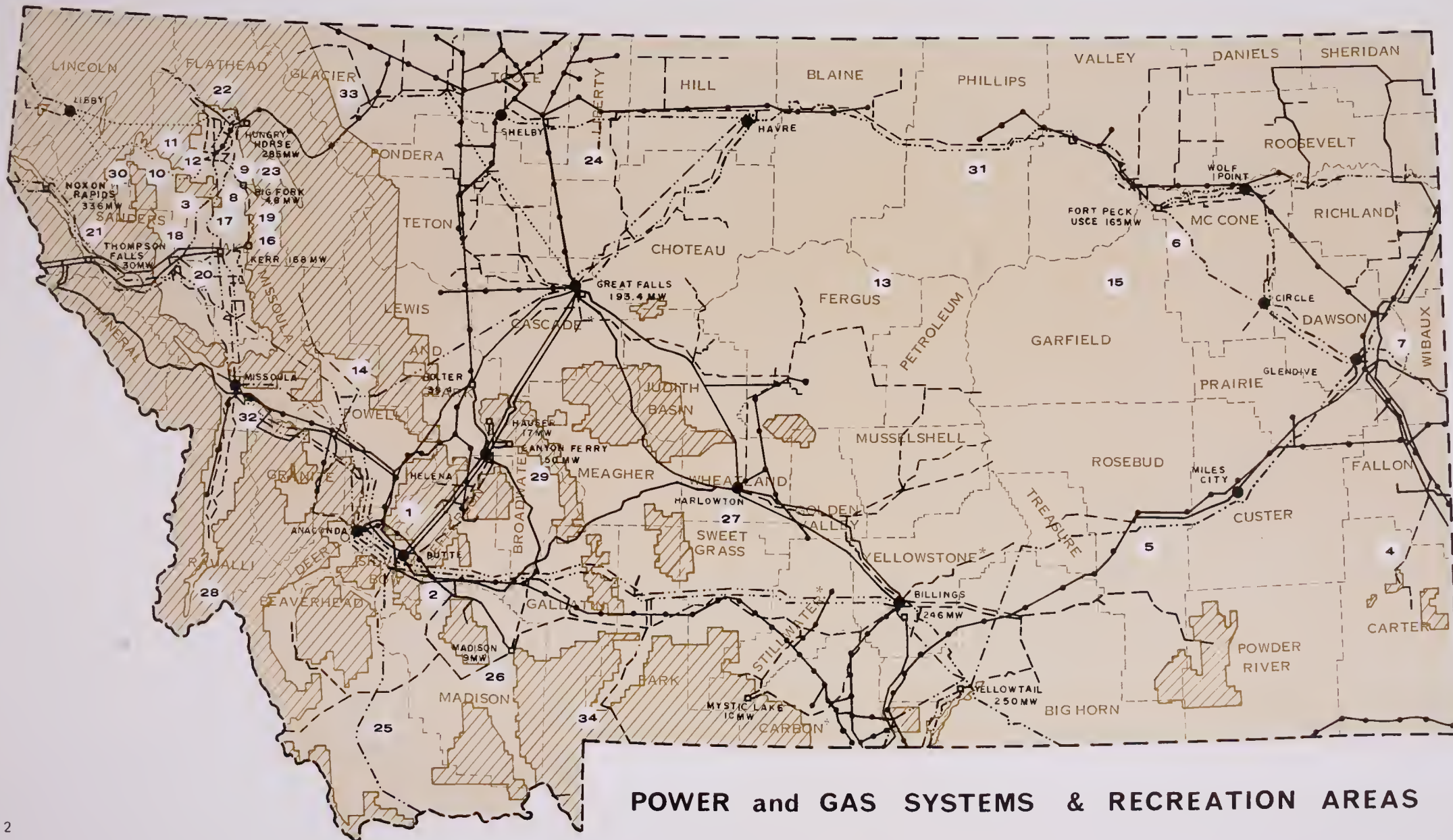


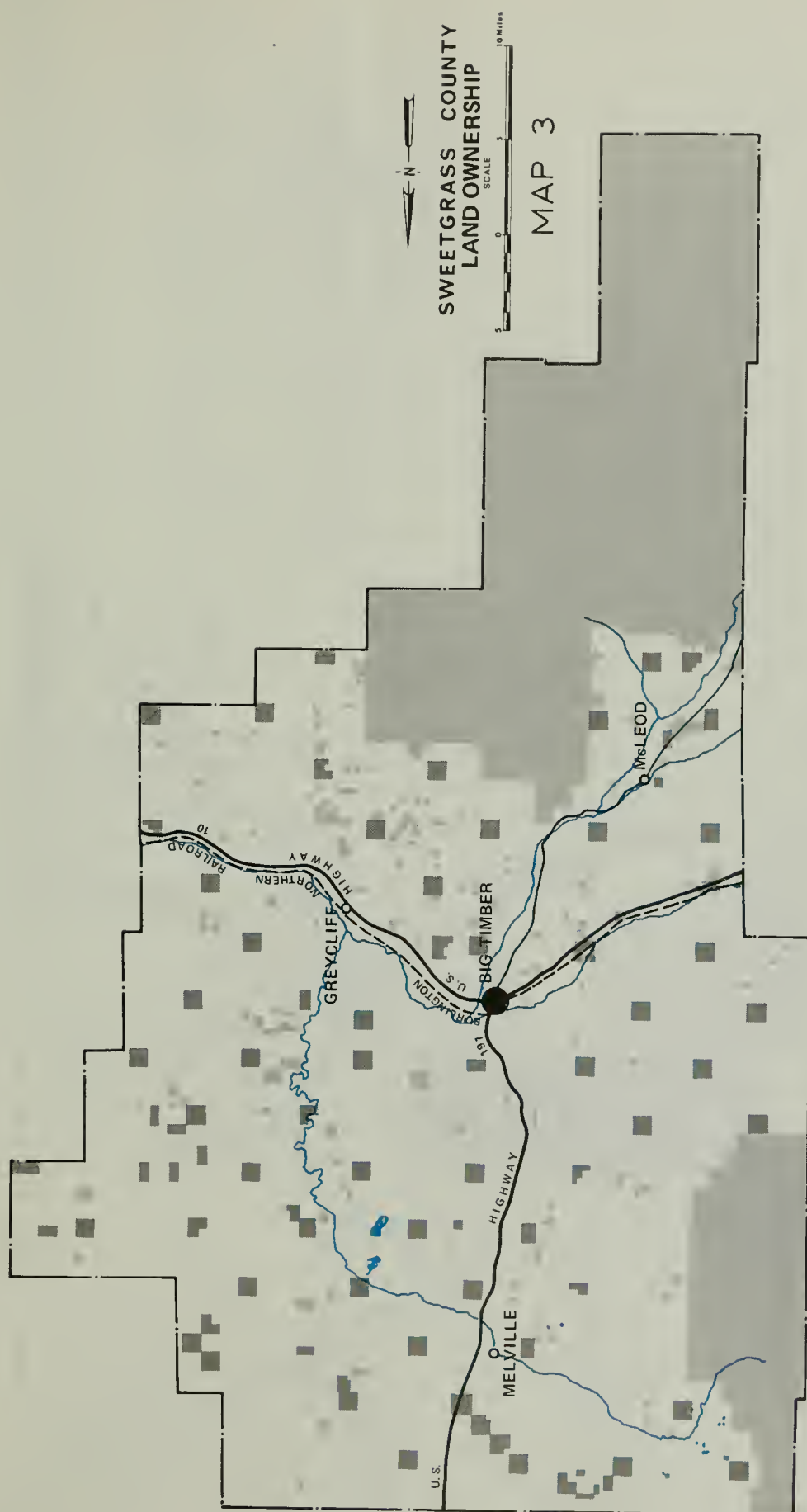
NEETGRASS COUNTY
LAND OWNERSHIP



MAP 3



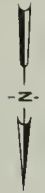
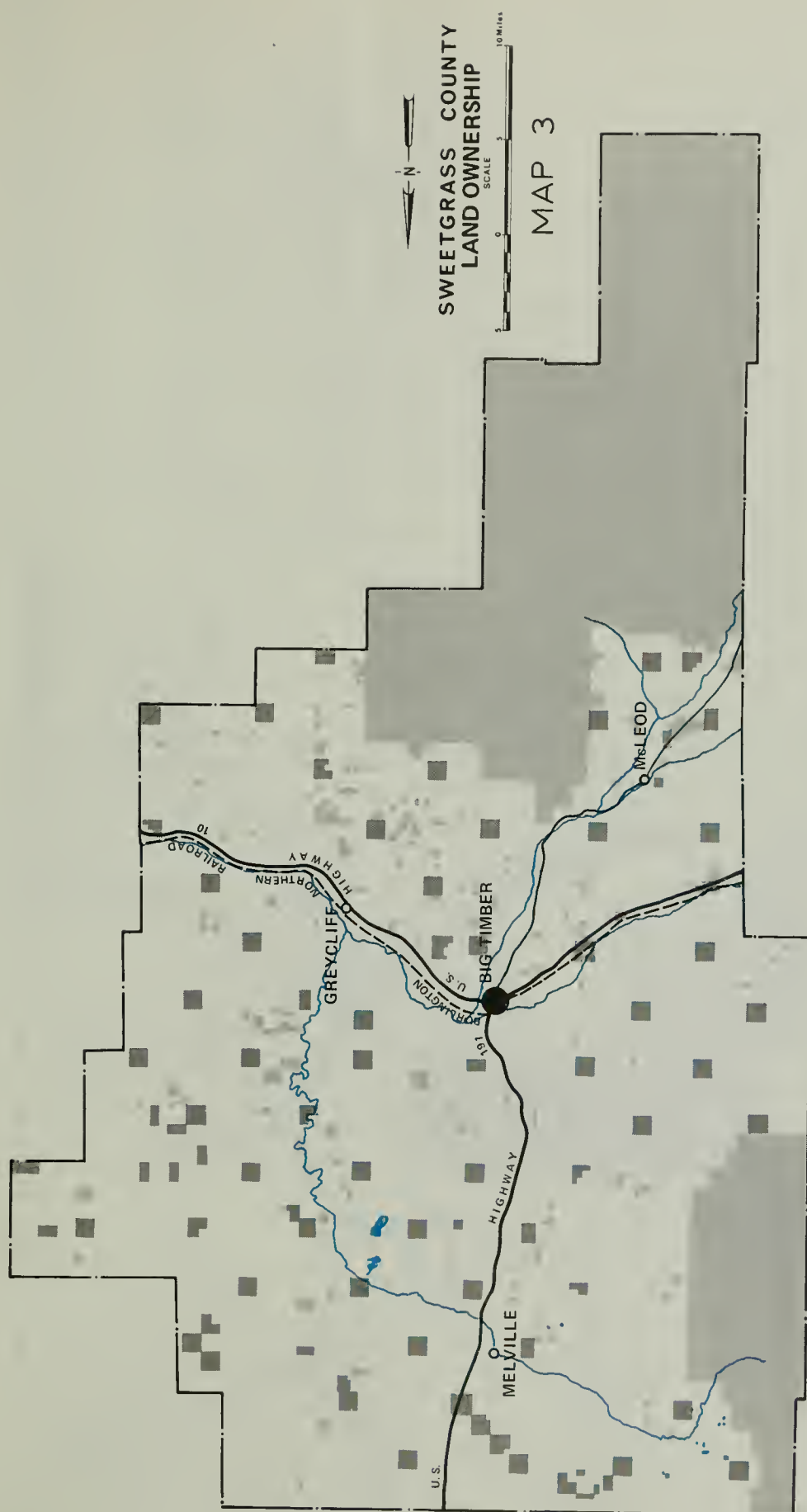




SWEETGRASS COUNTY
LAND OWNERSHIP

SCALE 0 5 10 Miles

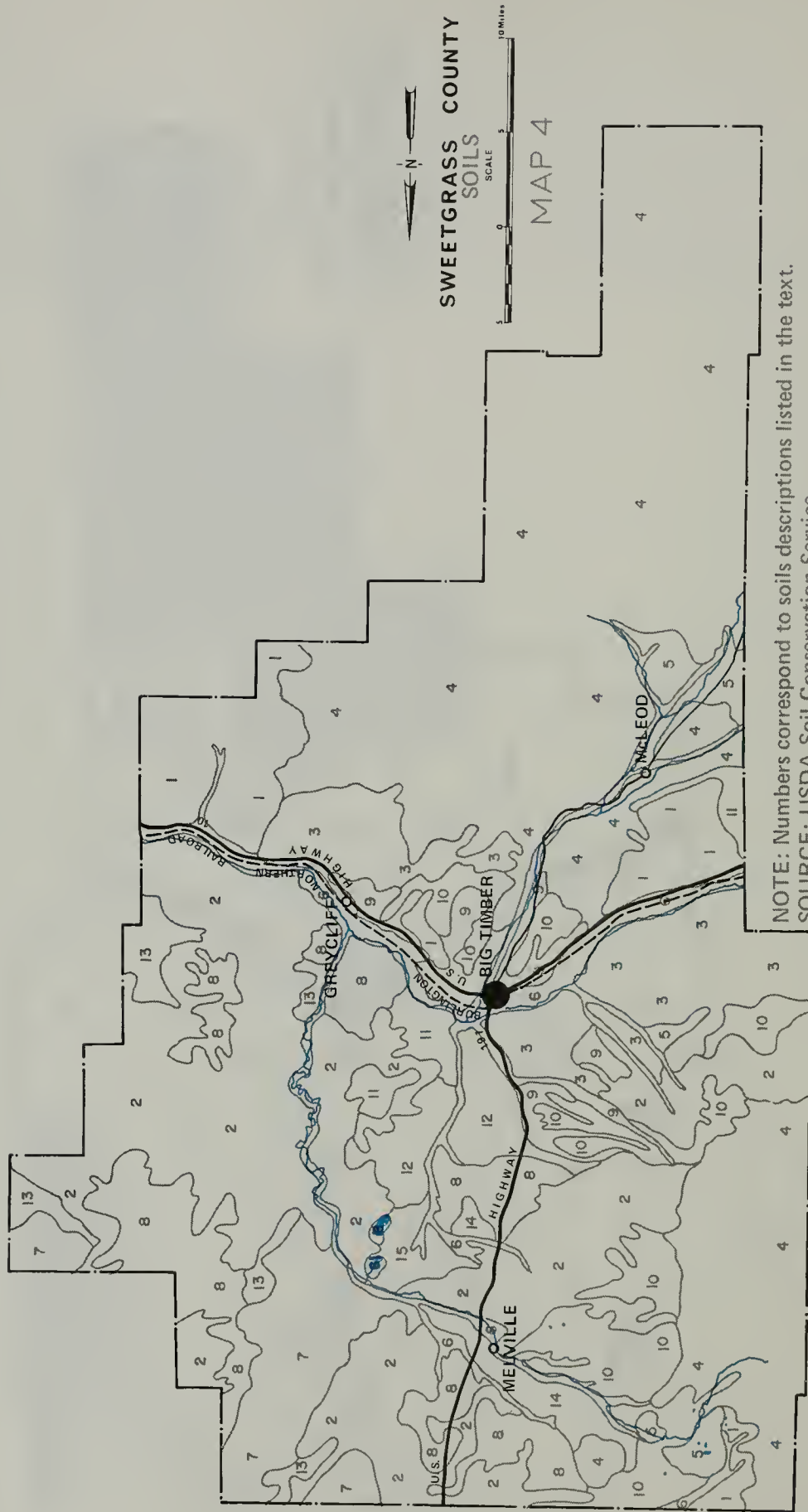
MAP 3

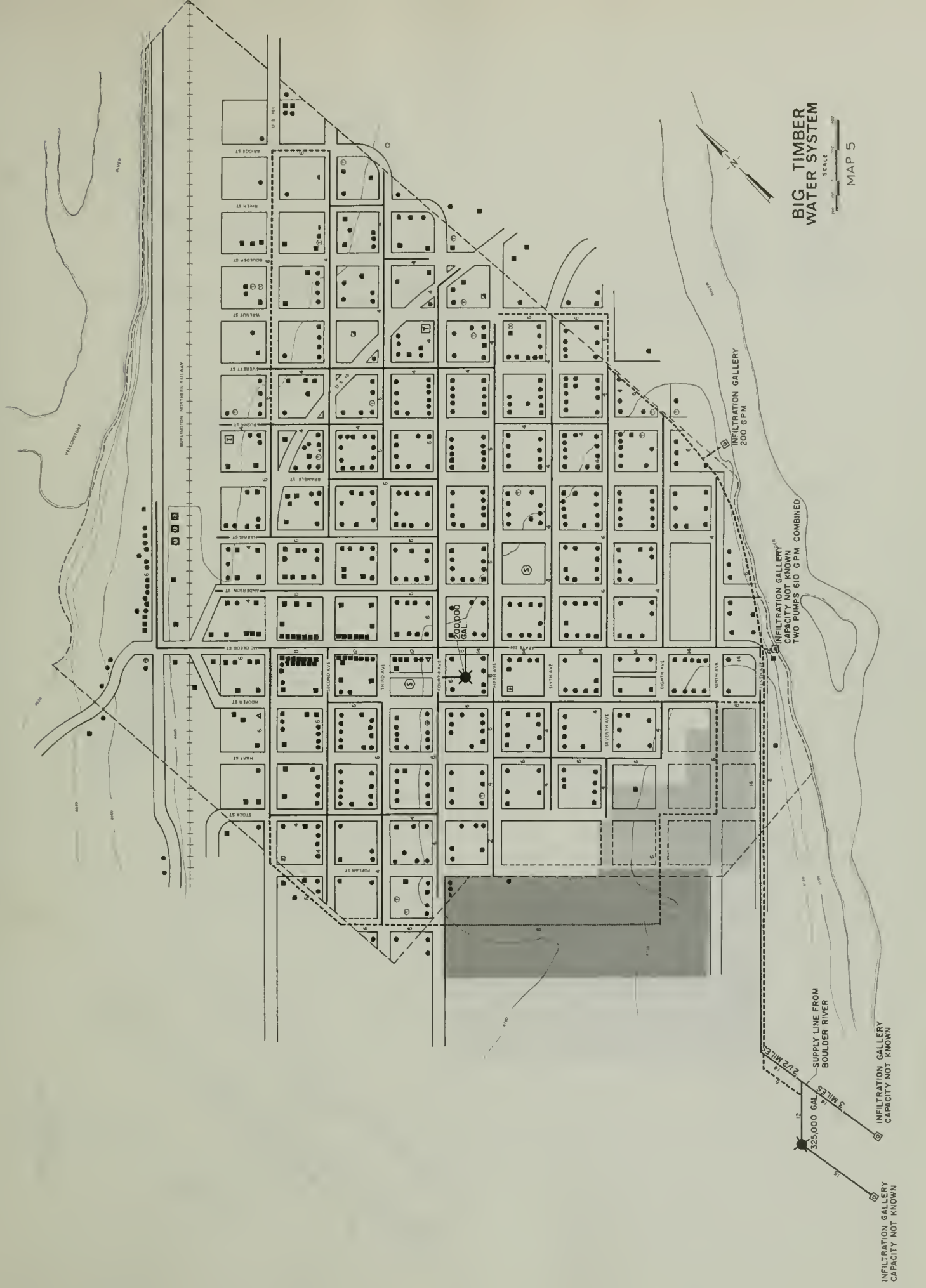


SWEETGRASS COUNTY
LAND OWNERSHIP



MAP 3





BIG TIMBER
WATER SYSTEM

SCALE
1" = 100'
MAP 5

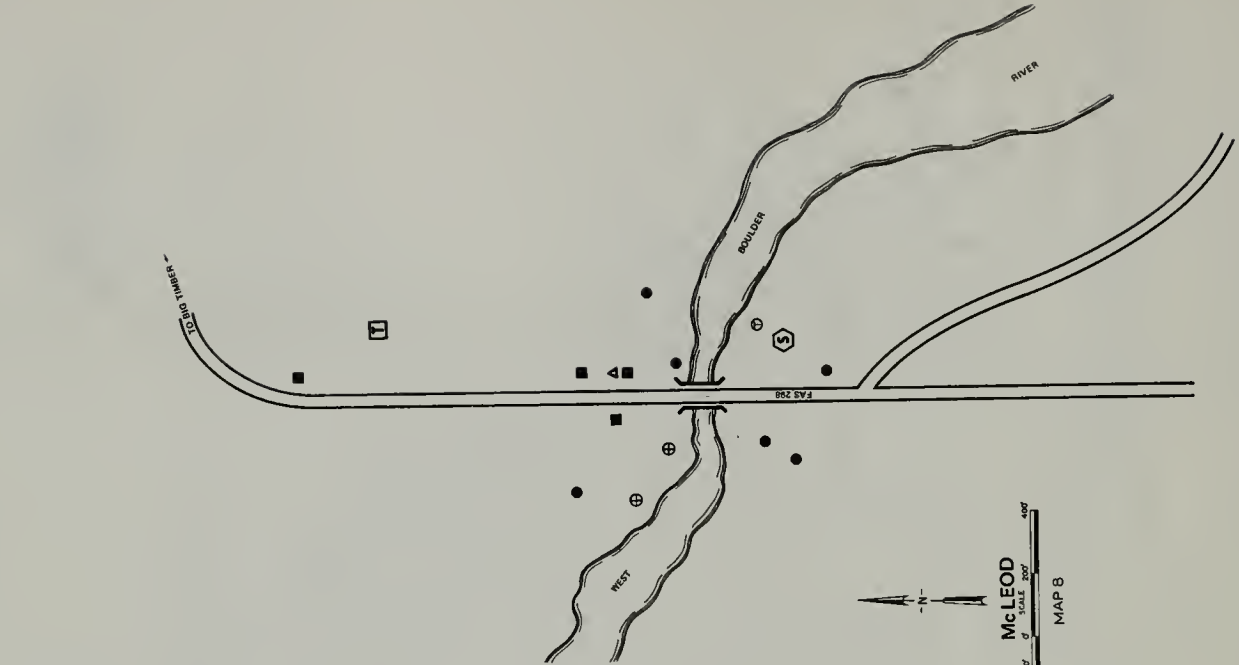
INfiltration GALLERY
200 GPM

INfiltration GALLERY
CAPACITY NOT KNOWN
TWO PUMPS 610 GPM COMBINED

325,000 GAL
SUPPLY LINE FROM
BOULDER RIVER

INfiltration GALLERY
CAPACITY NOT KNOWN

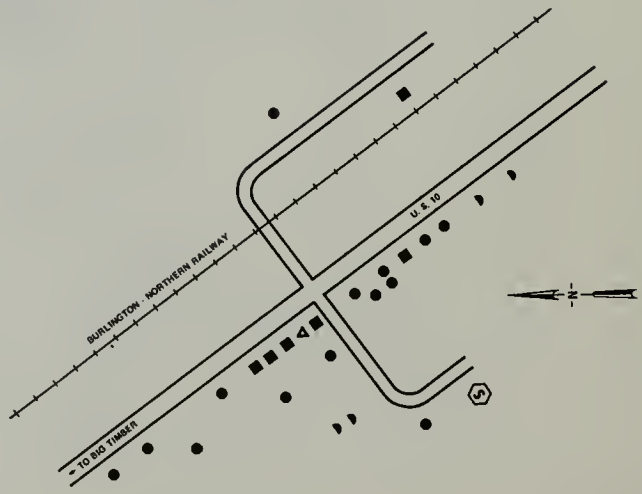
INfiltration GALLERY
CAPACITY NOT KNOWN



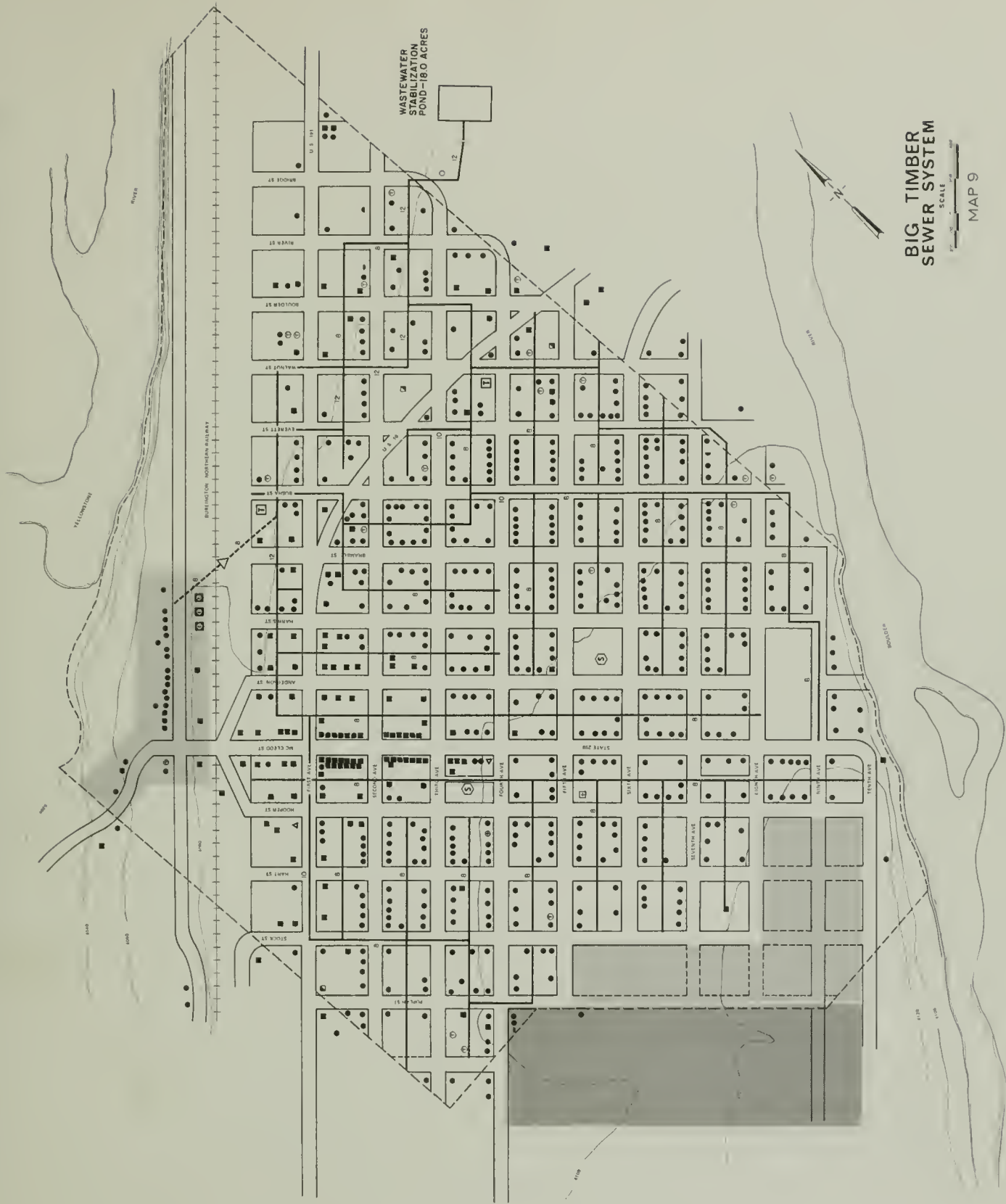
McLEOD
MAP 8
0 100 200 300 400
feet



MELVILLE
MAP 7
0 100 200 300 400
feet



GREYCLIFF
MAP 6
0 100 200 300 400
feet



**BIG TIMBER
SEWER SYSTEM**

SCALE
1" = 100'

MAP 9

APPENDICES

APPENDIX I.

MONTANA WATER LAW AND WATER QUALITY CRITERIA

SURFACE—WATER LAW

Two basic laws which concern surface-water rights are recognized in the United States. They are the Doctrine of Riparian Rights and the Doctrine of Prior Appropriation. The Doctrine of Riparian Rights originated in England and is in widespread use in the eastern United States. Basically, this doctrine gives the owners of land bordering a stream the right to have that stream flow past their land undiminished in quantity and unaltered in quality and to use it for household and livestock purposes. Under the Riparian Doctrine, the water is restricted to riparian owners, and it is unlawful for them to reduce significantly the flow of the stream.

It was determined early in the history of Montana that the Doctrine of Riparian Rights was unsuited to the conditions here. First, it was obvious that diversion and reduction of stream flow was a necessity to mining and agricultural uses, and second, much of the land in Montana was under public rather than private ownership. The Doctrine of Prior Appropriation was much more suited to the region and was formally adopted by the Montana Supreme Court in 1921. The appropriation right originated in California where the early gold miners diverted water from streams to placer-mine gold. Water rights were considered in the same manner as mining claims; those who were first in time were first in right and the quantity or size of right was determined by the amount beneficially used.

The five basic points of the Doctrine of Prior Appropriation are:

1. The use of water may be acquired by both riparian and non riparian landowners.
2. It allows diversion of water regardless of the reduction of the water supply in the stream.
3. The value of the right is determined by the priority of the appropriation, i.e., first in time is first in right.

4. The right is limited to the use of the water. Stream waters in Montana are the property of the state and the appropriator acquires only a right to their use. Moreover, this use must be beneficial.
5. A right to the use of water is considered property only in the sense that it can be bought or sold; its owner may not be deprived of it except by due process of law.

No water right may be acquired on a stream in Montana without diversion of water and its application to a beneficial use. The method of acquiring or appropriating a right to water has been outlined by the state legislature. The procedure for appropriation from an adjudicated stream is:

1. Posting of notice in a conspicuous place at the point of intended diversion stating:
 - a. quantity of water claimed
 - b. use for which water is claimed and place of use
 - c. description of means of diversion
 - d. date of appropriation
 - e. name of appropriator
2. Filing, within twenty days after date of appropriation, of a notice of appropriation with the county clerk including in addition to the posted notice:
 - a. name and description of the stream
 - b. description of point of diversion with reference to a permanent monument or natural marker
 - c. verification by affidavit of the appropriator that facts of the notice are true

Montana laws do not require that a water user file an official record of the completion of an appropriation. It is, therefore, a fact that in many instances the demand

for the water of a stream is much greater than the supply available. In such cases there is a means by which the rights and priorities of each user along a specific stream may be officially determined. The action of adjudication or water right suit may be initiated by any one or more of the appropriators. The Judge of the District Court then examines all of the claims and issues a decree establishing priority of right of each water user and the amount of water he is entitled to use.

The procedure for appropriation of water from adjudicated streams is slightly more complicated than that of unadjudicated streams. For adjudicated streams an appropriator shall:

1. Employ a competent engineer to survey the area and means of conducting water from its source to place of intended use.
2. Have aerial photographs and maps thereon to show the course of the intended diversion or location of intended impoundment.
3. File with the Clerk of the Court of the county of appropriation a petition which includes:
 - a. the amount of water sought by appropriation
 - b. a description of the watercourse or body from which water is intended to be appropriated
 - c. a description of the means of diversion or size, location and manner of construction if a reservoir is intended
 - d. the engineers survey and aerial photographs
 - e. a declaration by the appropriator that the rights sought shall be subject to and bound by any decree theretofore rendered adjudicating the waters or any body to which the waters may be tributary
4. Name all others who have or appear to have rights in the source of supply as defendants in the appropriation proceeding.

Upon completion of the above procedure, a trial is held and normally a decree results. If a new appropriation is granted, the appropriator shall be bound by all prior rights and decrees.

GROUND-WATER LAW

The quantity of ground water stored beneath the surface of the earth in Montana exceeds that on the surface. For many years use of this vast ground-water resource was very limited and no need for regulating its use was deemed necessary. In recent years the use and development of ground-water resources has increased considerably and it was realized that, without some means of regulation, ground water in some areas might be withdrawn at a faster rate than it could be naturally replenished.

In 1961 the 37th Legislative Session of Montana passed a bill which created a Ground Water Code in Montana (Chapter 237, Revised Codes of Montana, 1961). This bill became law on January 1, 1962, and the State Engineer of Montana was designated as the "Administrator."

The Ground-Water Law contains many provisions which are considered pertinent to this comprehensive plan, and, therefore, portions of these provisions will be presented in this report. They are:

Section 1. Definitions or Regulations As Used In The Act.

a. "Ground Water" means any fresh water under the surface of the land including the water under the bed of any stream, lake, reservoir, or other body of surface water. Fresh water shall be deemed to be the water fit for domestic, livestock, or agricultural use. The Administrator, after a notice of hearing, is authorized to fix definite standards for determining fresh water in any controlled ground-water area or sub area of the state.

b. "Aquifer" means any underground geological structure or formation which is capable of yielding water or is capable of recharge.

c. "Well" means any artificial opening or excavation in the ground, however made, by which ground water can be obtained or through which it flows under natural pressures or is artificially withdrawn.

d. "Beneficial use" means by economically or socially justifiable withdrawal or utilizations of water.

e. "Person" means any natural person, association, partnership, corporation, municipality, irrigation district, the State of Montana, or any political sub-division or agency thereof, and the United States or any agency thereof.

f. "Administrator" means State Engineer of the State of Montana.

g. "Ground-Water area" means an area which, as nearly as known facts permit, may be designated so as to enclose a single distinct body of ground water which shall be described horizontally by surface description in all cases and which may be limited vertically by describing known geological formations, should conditions dictate this to be desirable. For purpose of administration, large ground-water areas may be divided into convenient administrative units known as "sub-areas."

Section 2. Right To Use. Rights to surface water where the date of appropriation precedes January 1, 1962, shall take priority over all prior or subsequent ground-water rights. The application of ground water to a beneficial use prior to January 1, 1962, is hereby recognized as a water right. Beneficial use shall be the extent and limit of the appropriative right. As to appropriations of ground water completed on and after January 1, 1962, any and all rights must be based upon the filing provisions hereinafter set forth, and, as between all appropriators of surface or ground water on and after January 1, 1962, the first time is first in right.

Any ground water put to beneficial use after January 1, 1962, must be filed upon in order to establish a water right thereto. Four different types of forms have been provided for filing. The titles of the forms are:

Form No. 1 "Notice of Appropriations of Ground Water"

Form No. 2 "Notice of Completion of Ground Water by Means of a Well"

Form No. 3 "Notice of Completion of Ground Water Appropriation Without a Well"

Form No. 4 "Declaration of Vested Ground Water Rights"

Form No. 1 is optional and Form No. 4 was for those who had put ground water to a beneficial use before January 1, 1962. Again, it is important to recognize that the ground-water law states especially that, "Until a notice of completion (Form No. 2 or No. 3) is filed with respect to any use of ground water instituted after January 1, 1962, no right to that use of water shall be recognized."

WATER QUALITY

The State Department of Health, under the supervision of the State Water Pollution Control Council, is responsible for administering the water pollution laws of the state. As stated in the resume of Montana water laws published by the Montana Water Resources Board, "the Department of Health has supervision over all state waters which are directly or indirectly being used as a public water supply." The Water Pollution Control Council is responsible for classifying water and formulating a program for pollution control.

The Water Pollution Control Council has adopted specific "Water Quality Criteria;" established "Water Use Classifications;" and issued a complete list of "Policy Statements." The original adoption of these standards took place October 5, 1967, and since that time they have been made available to interested persons by the State Department of Health. A portion of the information available from the Department is the detailed chemical, physical, and biological standards of the "Water Quality Criteria" for effluent water. Water quality standards for domestic water, as set forth by the United States Public Health Service, are shown in Table A. The Montana Water Pollution Control Council "Policy Statements" and "Water Use Classifications" are presented in the following paragraphs.

The Water Pollution Control Council has added a new policy statement at the request of the Federal Water Pollution Control Administration. The new statement is:

Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at

the high quality unless it has been affirmatively demonstrated to the state that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required to provide the necessary degree of waste treatment to maintain high water quality. In implementing this policy, the Secretary of the Interior will be kept advised in order to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

The originally adopted "Policy Statements" are:

- 1. Quality of waters classified for multiple use shall be governed by the most stringent criteria listed for any use.*
 - 2. The Council has classified as "A-Closed" only those waters on which access and other activities are presently controlled by the utility owner. If other uses are permitted by the utility owner, these waters shall be reclassified "A-Open" or lower. Conversely, waters in the "A-Open" classification, if shown to meet the "A-Closed" criteria, may be so classified by the Council at the request of the utility owner. Where "A-Open" water is used for swimming and other water contact sports, a higher degree of treatment may be required for potable water use.*
 - 3. The water quality standards are subject to revision (following public hearings and, in the case of interstate streams, concurrence of the Federal Water Pollution Control Administration) as technical data, surveillance programs and technological advances make such revisions desirable. There are waters in the state on which little water quality data is presently available. Water quality criteria for these waters was established to protect existing and future water uses on the basis of the most representative information available.*
- In some cases, particularly in eastern Montana, waters have been classified "B" and "C" where the upper ends of the streams will probably be suitable for this use while the lower ends will not. However, not enough data is available to determine where the "B" and "C" designation should be dropped. Whenever a water supply or swimming area is developed, the regulations and the advice of the State Board of Health should be acquired. As time permits, data will be obtained and the classifications reviewed.*
- 4. As used in the Water Quality Criteria, the phrases "natural," "naturally present" and "naturally occurring" are defined as conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. Waters below existing dams will be considered natural.*
 - 5. It is the intent of the criteria that the increase allowed (temperature for example) above natural conditions is the total allowable from all waste sources along the classified stream.*
 - 6. Although the water quality criteria specify minimum dissolved oxygen concentrations, it shall be the policy of the Council to require the best practicable treatment or control of all oxygen-consuming wastes in order to maintain dissolved oxygen in the receiving waters at the highest possible level above the specified minimums.*
 - 7. For treatment plant design purposes, stream flow dilution requirements shall be based on the minimum consecutive seven day average flow which may be expected to occur on the average once in ten years.*
 - 8. Where sampling stations and points of mixing of discharges with receiving waters as mentioned in the water quality criteria are to be established on interstate waters, the concurrence of the Federal Water Pollution Control Administration will be solicited.*

TABLE A
Water Quality Standards

Characteristic	Permissible Concentrations in Milligrams Per Liter	Objections to Concentrations Beyond Permissible Limits
Turbidity	5*	Esthetic
Color	15 *	Esthetic
Threshold Odor Number	3*	Esthetic
Alkyl Benzene Sulfonate (ABS)	0.5	Taste, Foaming, Indicator of Pollution
Arsenic (As)	0.01	Toxic
Chloride (Cl)	250	Possible Laxative Effect
Copper (Cu)	1.0	Possible Physiological Effect
Carbon Chloroform Extract (CCE)	0.2	Toxicological Interest
Cyanide (CN)	0.01	Toxic
Fluoride (F)	See Below	Mottling of Teeth
Iron (Fe)	0.3	Esthetic, Staining of Laundry
Manganese (Mn)	0.05	Esthetic, Staining of Laundry
Nitrate	45	Methemoglobinemia
Phenols	0.0001	Taste
Sulfates	250	Possible Laxative Effect
Total Dissolved Solids	500	Possible Laxative Effect
Zinc (Zn)	5	Possible Laxative Effect
Radium-226	3**	Radiation Damage
Strontium-90	10**	Radiation Damage
Gross Beta Radioactivity	1,000**	Radiation Damage

Concentrations in excess of following should be re-examined before use (mg/l):

Arsenic (As)	0.05	Fluoride (F)	See Below
Barium (Ba)	1.0	Lead (Pb)	0.05
Cadmium (Cd)	0.01	Selenium (Se)	0.01
Hexavalent Chromium (+6)	0.05	Silver (Ag)	0.05
Cyanide (CN)	0.2		

Annual Average of Maximum Daily Air Temperature	Recommended Control Limits—Fluoride Concentrations in mg/l		
	Lower	Optimum	Upper
50.0 to 53.7	0.9	1.2	1.7
53.8 to 58.3	0.8	1.1	1.5
58.4 to 63.8	0.8	1.0	1.3
63.9 to 70.6	0.7	0.9	1.2
70.7 to 79.2	0.7	0.8	1.0
79.3 to 90.5	0.6	0.7	0.8

Hardness Standards for Water

Hardness in Milligrams per Liter	Degree of Hardness
0 - 35	Soft
36 - 100	Medium
100 - 150	Hard
Over 150	Extremely Hard

* Standard Units. ** Pico-curies Per Liter.

Source: Ameen, Joseph S., Community Water Systems, 1960

9. *It is not the intent of these criteria to provide for a swimming water immediately below an existing treated domestic sewage outfall.*
10. *Where common treatment is practicable, it is the policy of the Council to restrict the number of sewer outfalls to a minimum.*
11. *Tests or analytical procedures to determine compliance with standards will, insofar as practicable and applicable, be made in accordance with the methods given in the twelfth edition of "Standard Methods for the Examination of Water and Waste Water" published by the American Public Health Association, et al., or in accordance with tests or analytical procedures that have been found to be equal or more applicable.*
12. *Because of conflicting testimony, it is the intent of the Water Pollution Control Council to obtain additional information on temperatures and fisheries on waters below existing steam generating stations at Billings and Sidney on the Yellowstone River. This can probably be best accomplished by a cooperative study between the utility, State Fish and Game Department, Federal Water Pollution Control Administration and the Montana State Department of Health.*
13. *Insufficient information is available for establishing fixed sediment criteria at this time. Until standards can be set, reasonable measures, as defined by the Water Pollution Control Council, must be taken to minimize sedimentation from man's activities.*

Minimum treatment requirements set forth by the Council are:

1. *Domestic Sewage – the minimum treatment required for domestic sewage shall be secondary treatment or its equivalent with the understanding that properly designed and operated sewage lagoons will meet this requirement.*

2. *Industrial Wastes – the minimum treatment required for industrial wastes shall be secondary treatment or its equivalent.*

Definitions of the water use classifications assigned to the Columbia and Missouri Basins and the Hudson Bay drainage in Montana are:

"A-Closed" – Water supply for drinking, culinary and food processing purposes, suitable for use after simple disinfection. Public access and activities such as livestock grazing and timber harvest should be strictly controlled under conditions prescribed by the State Board of Health.

The Council has classified as "A-Closed" only those waters on which access is presently controlled by the utility owner. If other uses are permitted by the utility owner, these waters shall be reclassified "A-Open-D 1" or lower.

"A-Open-D 1" – Water supply for drinking, culinary and food processing purposes suitable for use after simple disinfection and removal of naturally present impurities. Water quality shall also be maintained suitable for the use of these waters for bathing, swimming and recreation (See "Note" below), (where these waters are used for swimming and other water contact sports, a higher degree of treatment

Note: Common sense dictates that swimming and other water contact sports are inadvisable with a reasonable distance downstream from sewage treatment facility outfalls.

may be required for potable water use); growth and propagation of salmonid fishes and associated aquatic life, water fowl and furbearers; agricultural and industrial water supply. Therefore, these waters shall be held suitable for "A-Open", "C", "D", "E" and "F" uses but may not necessarily be used for all such purposes.

Waters in this class, if shown to meet the "A-Closed" criteria, may be so classified by the Council at the request of the utility owner.

All waters within the boundaries of national parks and nationally designated wilderness, wild or primitive areas in Montana are classified "A-Open-D₁" except those adjacent to developed areas such as Snyder Creek through the community of Lake McDonald and Swiftcurrent Creek below the Many Glacier Chalet, both in Glacier National Park. Also, Georgetown, Flathead and Whitefish Lakes and Lake Mary Ronan are classified as "A-Open-D₁" as are some streams presently used for domestic water supply.

"B-D₁" The quality of these waters shall be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming, and recreation (see note under "A-Open-D₁"); growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "B-D₁" equals "B", "C", "D₁", "E" and "F".

"B-D₂" The quality of these waters shall be maintained suitable for the uses described for "B-D₁" waters except that the fisheries use shall be described as follows:

"Growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers."

Therefore, "B-D₂" equals "B", "C", "D₂", "E" and "F".

"B-D₃" The quality of these waters shall be maintained suitable for the uses described for "B-D₁" waters except that the fisheries use

shall be described as follows:

"Growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers."

Therefore, "B-D₃" equals "B", "C", "D₃", "E" and "F".

"C-D₂" The quality of these waters shall be maintained suitable for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "C-D₂" equals "C", "D₂", "E" and "F".

"D₂" The quality of these waters shall be maintained for growth and marginal propagation of salmonid fishes and associated aquatic life, water fowl and furbearers; agricultural and industrial water supply. Therefore, "D₂" equals "D₂", "E" and "F".

"E" The quality of these waters shall be maintained for agricultural and industrial water supply uses and "E" shall equal "E" and "F" uses.

"F" The quality of these waters shall be maintained suitable for industrial water supply uses, other than food processing.

- Sources:
1. "Montane Water Laws: A Resume," Inventory Series Report No. 5, Montana Water Resources Board, Helena, Montana, November, 1968
 2. "Water Resources Survey," Flathead and Lincoln Counties, Montana, State Engineer's Office, Helena, Montana, June, 1965
 3. "Water Quality Criteria," "Water Use Classifications," "Policy Statements," communication from Claiborne W. Brinck, Director, Division of Environmental Sanitation, State Department of Health, Helena, Montana, May 7, 1968

APPENDIX II.

COMMUNITY WATER SYSTEM FACILITIES

ANALYSIS CRITERIA

Complete designs of safe community water systems can become extremely complicated. Each design and analysis is usually a unique problem for that individual system. For this study, a general approach must be used; however, it is realized that a more detailed study may result in somewhat different findings and proposals. The following paragraphs contain a discussion of the approach used in arriving at general design criteria used herein.

In the analysis and design of water systems, the interrelations of supply, transmission, storage, and distribution must be considered. For example, if the water supply is not adequate to meet the peak hourly demand, storage is necessary to provide a reserve for the peak periods. The size of the various portions of the system is determined by establishing the average daily demand on the system.

The determination of daily water consumption is arrived at by considering records of existing systems. Usage varies over a wide range of about one hundred gallons per capita per day (gpcpd) to six hundred gpcpd. Usages of four hundred gpcpd are very common during hot weather. The basis of analysis used, herein, is two hundred gpcpd average. The accepted nationwide average daily demand value for a community water system is 125 gallons per day per person for domestic use. Records show that practically all Montana communities exceed this amount especially during hot weather, and the two hundred gpcpd is more in line with present day demands for communities in Montana.

Well capacities and capacities of other sources of supply must be sufficient to provide water for the average requirements and additional amounts to sustain peak periods. It is felt that a water source capable of supplying the total average daily demand by operating for a twelve hour period is a suitable basis for analysis. This means that the average daily demand doubled,

divided by twenty four hours per day and sixty minutes per hour, will result in a required rate of supply in gallons per minute. It is realized that this source may be required to operate more than twelve hours during high demand periods. This freedom in operation, combined with storage facilities, is intended to provide the necessary flexibility to handle low and high demand periods economically.

It is common practice to provide storage facilities with capacity equal to the supply necessary for one average day. This will provide storage for fire protection and any excess will add to the flexibility of the system. Table B shows desired storage for fire based on population. This information corresponds to requirements of the Montana Fire Rating Bureau and is taken from "Community Water Supplies" by Ameen.

During certain times of the year water consumption will exceed the average figure of two hundred gpcpd. The system analysis must be checked to determine the amount of water actually available to supply such demands. The estimated 1990 population is used for this check so that population increases are considered. Also, it is expected that the source will have to operate for more than the twelve hour period and any storage in excess of the recommended reserve for fire will be available for domestic consumption. The recommended storage for fire is shown in Table B.

It is considered that the source must produce water for an eighteen hour period. This value, times the well yield, results in a value for the amount of water that can be put into service per day. Also included is the storage not required for fire reserve. The sum of those two values divided by the 1990 population, yields the water available in gallons per capita per day. If water demand exceeds this amount, meters or some other means of controlling water usage must be employed. The above approximate approach results in an adequate amount of water being available and is considered to be the general

analysis criteria which is applicable for all the communities studied.

Desired Yield of Source (gpm) 1.5 to 2.0 x Average
Daily Consumption
 24 Hour/Day x 60
 Minute/Hour
 One Average Day's
 Supply

Summary of Analysis Criteria

Average Daily Water Consumption (gpcpd) 200
 Desired Output of System (gpcpd) 400

Desired Storage

TABLE B

Desired Storage For Fire

Population	Storage (Gals.)	Population	Storage (Gals.)
200	26,800	2,200	92,800
400	33,400	2,400	99,400
600	40,000	2,600	106,000
800	46,600	2,800	112,600
1,000	53,200	3,000	119,200
1,200	59,800	3,500	135,800
1,400	66,400	4,000	152,400
1,600	73,000	4,500	169,000
1,800	79,600	5,000	185,600
2,000	86,200	5,500	202,200

Source: "Community Water Systems" by Ameen.

APPENDIX III.

COMMUNITY SEWER SYSTEM FACILITIES

ANALYSIS CRITERIA

The Montana State Department of Health has adopted the "Ten State Standards" as the criteria for the design of the various elements of the sewer system. Proposals contained herein are based on the recommendations of these standards.

Wastewater stabilization ponds are considered to be the most suitable means of sewage treatment for most smaller communities. The recommended sizes are derived from the criteria of one acre per one hundred population. This criteria is adequate if normal domestic sewage is encountered for all cases; however, more detailed study and analysis is required for final design.

Sewage collection and outfall mains are to be a minimum of eight inches in diameter according to the "Ten State Standards". This minimum is established since reasonably maintenance free systems will result. In many small communities, the sewage flow does not

justify this size; however, the possibility of plugging is minimized.

Capacities for the various size lines are determined for minimum grades with the pipe flowing two thirds full and are shown in Table C. Where sewage force mains are required, a minimum of four inch pipe is proposed. Larger lines are sized according to anticipated flow.

Criteria for the sewage flows used in this study are as follows:

Average sewage flow	100 gpcpd
Peak sewage flow (laterals)	400 gpcpd
Peak sewage flow (trunk and outfall)	250 gpcpd
Treatment facilities	100 gpcpd

The nominal determination of pond size is based on the following:

$$\frac{100 \text{ gpcpd} \times 180 \text{ day stor.} \times 7.5 \text{ gal/cu ft}}{5\text{-ft water depth} \times 43,560 \text{ sq ft/acre}} = \frac{\text{one acre}}{100 \text{ people}}$$

TABLE C
Average Capacity of Lines*

Pipe Diameter (inches)	Average Flow (gpm)	Population Equivalent (400 gpcpd flow)
6	110	390
8	200	720
10	320	1,150
		(250 gpcpd flow)
12	510	2,920
15	780	4,480
18	1,080	6,220
24	1,870	10,800

* Flowing two thirds full at minimum grade

